THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 58 Thursday, June 9, 1938 No. 1138

PUBLISHED WEEKLY

Subscription Terms : 17s. 6d. per annum.
Foreign and Colonial : 20s. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT : 1937-38

C. W. Bigg, "Selworthy," Burley Lane, Quarndon, near Derby.

LIST OF SECRETARIES—

General Secretary : T. Makemson, Saint John Street Chambers, Deansgate, Manchester, 3. London Office : 49, Wellington Street, London, W.C.2.

Birmingham, Coventry and West Midlands : A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham, 3.

East Midlands : B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.

Lancashire : J. E. Cooke, 7, Warren Drive, Swinton, Manchester.

London : R. Causebrooke, 333, Eton Road, Ilford, Essex.

Middlesbrough : G. P. Kirk, North-Eastern Iron Refining Company, Limited, Stillington, Stockton-on-Tees.

Newcastle-upon-Tyne : C. Lashly, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.

Scottish : J. Bell, 60, St. Enoch Square, Glasgow.

Sheffield : T. R. Walker, M.A., "The Priory," Oughtibridge, near Sheffield.

Wales and Monmouth : J. J. McClelland, 12, Clifton Place, Newport, Mon.

West Riding of Yorkshire : S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

South Africa : F. C. Williams, Magor House (Fifth Floor), 74, Fox Street, Johannesburg.

Bristol : A. Hares, Park Crescent, 648, Stapleton Road, Bristol, 5.

Burnley : W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.

East Anglian : J. L. Francis, 12, Glenhurst Avenue, Colchester Road, Ipswich.

Falkirk : T. R. Goodwin, "Viewfield," Falkirk Road, Bonnybridge, Scotland.

Lincoln : E. R. Walter, M.Sc., The Technical College, Lincoln.

The Institute of Vitreous Enamellers

President : Sir Harold Hartley, F.R.S., Euston Station, London, W.C.1.

Chairman : W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.

Hon. Secretary : Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President : A. C. Turner, Russell House, Adelphi, London, W.C.2

Secretary : K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President : W. E. Clement, Morfa Foundry, New Dock, Llanelly.

Secretary : J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. are :—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone : Colmore 4274-4275 *Telegrams : CIRA*

The B.C.I.R.A. Scottish Laboratories are :—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone : 332

Contents

	PAGE
British Foundry Progress	453
Book Reviews	454
Correspondence	454
Random Shots	454
Some Factors in Sand Testing	455
Catalogue Received	456
International Mechanite Metal Research Institute	457
Cleansing Provisions of Factories Act	457
Elliptical Blast Furnaces	457
Castings *versus* Forgings	458
Notes from the Branches	460
The Foundry of Ruston & Hornsby, Limited, Lincoln	461
Acid Smelting in Blast Furnaces	468
The Week's News in Brief	470
Trade Talk	470
Obituary	470
Personal	470
Company Reports	470
Aluminium Gaining Ground	470
R.A.F. Expansion	470
Forthcoming Events	470
Raw Material Markets	472
International Ferro-Silicon Syndicate	472

British Foundry Progress

Recent weeks have taken us into a number of widely separated foundries, and we have been particularly pleased with the efforts the industry is making to keep up to date. If there be an outstanding feature, it is still that of the supremacy of individualism. Certainly, two of the works visited were very similar in lay-out and equipment, but in the one case synthetic sands had been standardised for general use, whilst in the second, naturally-bonded sands were exclusively employed. Whilst, in general, full knowledge of the technique of continuous casting is both known and appreciated, there is more than a tendency to create a plant capable of doing this, but to work in batches so as to ensure a maximum of control. With continuous production, there are always waves, but controllable waves, of progressive amelioration or deterioration of the sand. Normally, these are kept well within bounds, but a change of patterns which alters the ratio of sand to metal will have a marked, even though a temporary, influence. Another tendency noted is the effort made to ensure the cleanliness of the ladles and shanks, associated with refined methods of handling to conserve heat and reduce the slag inclusion nuisance to a minimum. A daily relining has in some cases entirely superseded patching.

Much more care is being bestowed upon the fettling shop, and the continuous cleaning machines, the output of which is controlled by the speed of feeding, are a noteworthy improvement for the fettling of medium and light weight sturdy castings.

Progress has been registered in the provision of the diverse kinds of sands demanded by the large jobbing foundry and by using green sand as a basis for the manufacture of loam, by relating the composition of green sand and dry sand, a rational basis for complete control has been established. This system permits of the indiscriminate mixing of the used sand, and with this mixture the standard grades can be prepared therefrom, by the batch system of mixing. The reclamation in bulk of burnt core sand is now *un fait accompli*, and its commercial implication can be gauged by the fact that one foundry has been removing from its premises a matter of ninety tons of burnt sand *per diem*. It is not to be inferred that the new system to which we refer is applicable in this or in any other case, for as the foundry manager well knows, "what is one man's meat is another man's poison." Obviously the degree of "burning" varies from casting to casting, and modifications may be essential before success is finally if ever achieved.

Generally speaking, there is still room for improvement in the getting of liquid metal in the moulds, especially where the moulds of varying heights have to be dealt with whilst moving along a conveyor. Some firms have solved the problem reasonably satisfactorily, but finality has not yet been reached. This also applies to the knock out, and again this problem is of lesser magnitude when intermittent pouring is practised.

Greater use is being made of inclined belt conveyors for handling sand. They require more space, but maintenance is definitely less. Yet with increased knowledge and experience of belt and bucket elevators, we should hesitate to state that they are approaching obsolescence. On the contrary, we would rather postulate that it is much easier to make a hundred per cent. success of a bucket and belt elevator than to design a cheap motor-car. Considerations of space *do* commend their use.

The use by one firm of female labour, not only to make, but also to assemble the larger cores on jigs ready for final setting by the moulders, gives much food for thought. It shows a means for extending the productive capacity of foundries not usually thought of as lending themselves to such a system.

Finally, all the developments noted above indicate in the clearest possible manner just what is happening in the conduct of modern foundries. They show that there is an increasing and more intelligent co-operation between the equipment engineer and the foundry manager; and that the conduct of the industry is being rapidly transferred from the "floor" to the "office" and "laboratory." Consequently the position of the foundry manager is becoming much more onerous and of a more responsible character. The skill of the experienced moulder is no longer expended upon the production of a single casting, but is recorded and expanded to create the fundamental knowledge of the industry. For instance, information is now being assembled as to the "best" pouring speeds for all types of moulds. Our recent survey has convinced us that the British foundry industry is at least as intelligently managed as that of any other industrial country. In parts it is as well equipped, but there is still a very large number of foundries which call for large-scale capital investment to bring them into line with modern industrial conditions.

Book Reviews

The New Management. By H. T. Hildage, T. G. Marple and F. L. Meyenberg. Published by Macdonald & Evans, 8, John Street, Bedford Row, London, W.C.1. Price 16s.

This easily-read book is the most interesting the reviewer has seen on management. The description of certain works is such that a vivid picture of the layout is visualised, and reference to diagrams is unnecessary. Stress is laid on the necessity of having an idealistic outlook to be a successful manager, and the authors almost agree with what the reviewer has always contended—"The perfect manager is born, not made."

The principles of management are well defined and will interest not only the student but also those who have obtained prominent positions as managers. For the foundryman, no doubt the most interesting examples of application will be found in the chapters dealing with the "Reorganisation of Equipment in Steel Making" and "Chipping of Steel Billets," but of great value are the well-written sections on "Time Study and Inspection," which are capable of extensive application in the foundry.

J. W. G.

Foundry Sands, with Special Reference to Steel Foundry Practice. By T. R. Walker, M.A. (Cantab.), F.I.C., F.G.S. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 4s. net.

This book is particularly welcome inasmuch as it is the first work of a practical nature so far published in this country. Accordingly, one hesitates to be critical in view of the urgent need of as much information as possible on this subject being available to those connected with foundry work in all its varied branches. Probably the few investigators who have made a particular study of sands will be disappointed as the text only covers a very small part of the data now available. The author has overcome this to some extent by keeping his remarks pertinent to steel casting production. Furthermore, many practical workers will probably consider that the author could have been more definite in outlining recommended test methods, and the value of the book would undoubtedly have been enhanced if much more space had been allocated to the requirements of iron and non-ferrous founders as well as the important subject of sand handling and preparation equipment. In fact, it would have been well worth making this pioneer volume double size, as the only serious fault is that founders on the whole will want much more information than is available in the book in its present form. At its low price, however, it can be recommended as a very profitable investment for all connected with the industry, as the subject is presented with practical clarity and accuracy. There are 22 illustrations, of which seven are photomicrographs.

F. H.

Gases and Metals. An Introduction to the Study of Gas-Metal Equilibria. By Colin J. Smithells, M.C., D.Sc. Published by Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2. Price 18s. net.

There can be no question that a knowledge of the behaviour of gases and metals in contact with each other is of first-class importance to-day in connection with several branches of science and industry. In the metallurgical field, the greater solubility of the commoner gases—hydrogen, oxygen and nitrogen—in the molten as compared with the solid state of a metal is a primary factor which must be considered and allowed for if sound ingots and castings are to be produced. In addition, the actual amounts of gas remaining in solution in the solid metal are not without influence on the latter's properties. The metallurgical importance of gas-metal reactions does not end here, however; they are the controlling factor, for example, in the oxidation of steel and other metals when heated in air or other oxidising gases at high temperatures, in the decarburisation of metals containing carbon when exposed to hydrogen at even moderate temperatures and in the nitriding of steel.

Gas-metal reactions may be considered from three aspects—adsorption, diffusion and solution—and these form the headings of the three chapters into which Dr. Smithell's book is divided. Each chapter consists of a critical summary of the available information on the subject, often gleaned from sources not easily accessible to the metallurgist.

The book has apparently been written mainly from the point of view of the physical chemist and is largely concerned with the attempts which have been made to discover the fundamental laws governing the adsorption, diffusion and solution of gases in metals. This aspect is of particular interest to the author (owing to its importance in the manufacture of electric lamps, thermionic valves and other parts which depend largely on the production of very high *vacua*) and is, of course, of primary importance in all matters concerning the mutual action of gases and metals. He has done the work well, so that students will find in his book a clear, well-written account of what is known regarding gas-metal reactions and also, of especial interest, a description of the various methods used in obtaining the data which are quoted.

From the practical metallurgical standpoint, however—*i.e.*, the application of these fundamental laws to present-day problems connected with the production and working of metals—the book is less satisfying. One can well imagine that limitations of space prevented the author from giving more attention to these practical matters; but, perhaps, one may hope that in either a future edition or a second volume of the book he will give the benefit of his knowledge on these complex practical problems which are linked up with gas-metal equilibria.

J. H. G. M.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

To the Editor of THE FOUNDRY TRADE JOURNAL.

Moulding Sands

SIR,—We note in the published discussion on our Paper on Moulding Sand two statements which do not coincide with the replies made by the authors on the occasion of the presentation of the Paper at Bradford. Probably these mistakes are due to typographical errors, but as they each have an important bearing on the subject, we would ask you to make the necessary corrections. The first point arose during the report of Mr. A. W. Walker's reply to Mr. A. S. Worcester, the correct wording should read "but an examination of the firing point of coal tar" instead of "fusion point of coal dust or tar." The other error is more apparent and occurs on the third line of your second column: "but the slight addition of 5 per cent. moisture" should read "0.5 per cent. moisture."

We thank you for the otherwise exact and neat presentation in the JOURNAL, which is much appreciated.—Yours, etc.,

S. CARTER.
A. W. WALKER.

Huddersfield.
June 4, 1938.

A GRATIFYING INCREASE in membership was reported at the annual meeting of the Birmingham Metallurgical Society on Tuesday. The following officers have been elected for the ensuing year: President, Mr. A. L. Molineux; vice-presidents, Mr. A. Pinkerton, Mr. C. H. H. Franklin, Dr. Maurice Cook, and Mr. C. O. Wagner. Mr. F. G. Tustin continues as secretary.

Random Shots

When the vitreous enamellers visit America in the near future they certainly mean to make full use of that country's wonderful air liner service, a service with a time table as detailed and comprehensive as any English railway guide. One of the air line companies issues an enterprising brochure announcing the joys of travel by air and telling of the unaccustomed experiences and sights to be enjoyed thereon. Whilst you are deprived of the exciting pursuit of ever-changing shadows (for the simple reason that the shadow of the plane in flight never varies) you are compensated by the possibility of seeing circular rainbows, to say nothing of three sunsets and three sunrises in three-quarters of an hour!

* * *

Whilst America can beat us hollow in certain physical phenomena, little England is no longer impressed by such statements as that you can fly from New York to Chicago in less time than you can fly across the city of Honululu. Only a few weeks ago a prominent vitreous enameller flew to Dublin and back in less time than it took him to get from Croydon to a North London suburb.

* * *

There is an old barn in Ohio, so it is claimed by the writer of the booklet, the rain falling on one side of which flows to the Atlantic, whilst the rain on the other side goes to the Gulf of Mexico. But then, the Welsh can proudly show their visitors a stream on Plynlymmon which flows in two directions at once!

* * *

As for the party's plan to visit Colorado, one wonders which is the greater attraction; to get there they will have to spend the whole night in an air liner, certainly an unusual experience for most Englishmen; and having got there they can drink soda water out of a well instead of from the familiar syphon. The booklet does not say whether or not there is a whisky well next door.

* * *

Not only do American lines lure you into their 'planes with promises of extraordinary sights, but they entice you with delicious foods. You may look forward with ever increasing appetite to a dinner of assorted relishes, roast turkey, buttered peas, Mainliner salad and ice cream all complete. A pretty legend at the bottom of the menu reads: "It is our pleasure to serve you this meal with our compliments." Heaven forbid it should be the unhappy traveller's displeasure to re-deliver such a meal with his compliments into a certain handy little container!

* * *

Good advice to fathers wishing to cultivate a flare for business in young son was given at the recent Meehanite dinner. Having placed little Tommy on the table, his father told him to jump. "Don't be afraid," said he, "I'll catch you." Little Tommy jumped, but crashed to the floor as his father made no attempt to catch him. Picking the weeping child up tenderly, he remarked—"That's your first lesson in business, my son. Trust no one; not even your father."

* * *

And yet the extraordinary fact is that the whole of business is built up on trust. Even as the wily grocer passes you your pound of sausages he automatically expects, without any palpitating moment of doubt, to receive his just due. Nobody would be more surprised than he if you were to grab the sausages and run!

"MARKSMAN."

Some Factors in Sand Testing*

By T. R. WALKER, M.A.

The object of sand testing is to discover what properties of a sand influence its behaviour in a foundry, and to devise methods for assessing these properties numerically. In this way, numerical values for the properties of sand mixtures giving good results in the foundry may be determined, and satisfactory mixtures may be produced from successive consignments of the same raw sands. Although sand testing is of only recent development, its methods have progressed so far that it can be used for the routine control of sand mixtures in foundries. For this purpose, the determinations usually carried out are of the green crushing strength, water content and permeability. Each of these can be determined in a few minutes, so that it is possible to examine every batch of sand in a foundry as it is mixed, without interfering at all with the rate of production of moulds. This testing, whilst of value in any foundry, is of particular assistance in foundries making large numbers of similar castings, where every material must be reasonably constant in its properties day after day, if successful results are to be obtained regularly in endless repetitions of the same operations.

In these determinations there is satisfactory agreement between the results obtained by the same operator using the same apparatus, and testing the same kinds of sand mixtures day after day. Although the figures obtained in this way are sufficiently accurate for the control of foundry batches, a much higher standard is called for in investigatory or research work, where results must be reproducible at will by different operators in separate laboratories. Present knowledge of the factors which determine the foundry behaviour of a sand is still far from complete, and unless methods of examination are standardised so that investigators in different countries, carrying out tests according to a standardised procedure and using the same type of approved apparatus, can obtain identical results on testing the same sand, rapid progress in correlating sand properties and foundry behaviour will be impossible.

In addition to the testing of sand mixtures in the foundry, it is necessary to examine raw sands, both natural moulding sands and silica sands. It is also essential to be able to determine accurately the binding power of bonding materials used to develop green and dry strength in sand mixtures used in the foundry. The factors involved in these investigations are so numerous that it is possible here to touch on only a few of them.

The mechanical strength of a sand may be determined in either the green or the dry state, and it may be found with reference to tensile, compressive or shear stresses. All of these influence the behaviour of the sand in moulds, either during moulding or during casting, but to different extents in different circumstances. The strength value of a given sample of sand is not the same when measured in these three different ways. In the present Paper only the determination of green and dry strength in compression will be considered, this being the most popular method of testing at the moment.

Preparation of Specimens

In order to test a sand it must be formed into some kind of specimen. It is found in practice much easier to prepare a cylindrical specimen than one which is rectangular in cross-section, since the presence of edges along the length of rectangular specimens increases the difficulty of making a satisfactory test-piece. For this reason the cylindrical test-piece has been adopted as standard by most investigators in sand testing. The dimensions of such cylinders are important, since the difficulty in preparing good specimens increases as the diameter is reduced.

The cylinders which are widely used are (1) the one standardised by the American Foundrymen's Association, which is 2 in. long by 2 in. diameter, and (2) that recommended by the British Cast Iron Research Association, which is 2.256 in. long by 1.128 in. dia. This latter diameter was chosen since it gives a cross-sectional area of one square inch, and so simplifies subsequent calculations in the English system.

Forming Test-Pieces

The method of forming the cylinder involves considerable practical difficulty. It is possible to mould each type of cylinder by hand, using small pointed chisels for ramming, and this method, when carried out by a skilled operator, gives a reasonably uniform cylinder; but it is more difficult to make a satisfactory B.C.I.R.A. cylinder in this way than an A.F.A. cylinder, on account of its smaller diameter. With less skilled workers, hand preparation is liable to give very poor results from a uniformity point of view, and this method cannot, therefore, be considered when the standardisation of methods is in question.

In the method of ramming standardised by the American Foundrymen's Association, the sand is placed in a cylindrical former and given three blows with a standard ram, which is allowed to fall through a standard height. In this way the specimen absorbs a standard amount of energy, the amount of sand being chosen so that the finished cylinder is of the dimensions required, and the apparatus being placed on a rigid foundation to ensure that all the energy of the moving ram is absorbed by the specimen. It is evident that, in forming a cylinder in this way, the relative density of the cylinder will vary with the type of sand. In addition, the density of the cylinder will not be uniform in every part, but will be greatest immediately under the ram.

In the double-compression method advocated by Mr. W. Y. Buchanan, a cylinder 2.56 in. by 1.128 in. is prepared by ramming a specimen of sand to a predetermined length in a former by means of blows on one end, after which the test-piece is reversed and the ramming completed by repeating the operation at the other end, until the test-piece is of the specified length. In this way a cylinder is prepared which is more uniform than the A.F.A. cylinder, and may be of any desired relative density. The energy absorbed in forming the test-piece is, however, not constant as in the standard ramming of the A.F.A. test-piece, but varies according to the relative density of the specimen.

For purposes of sand control in the foundry, the 2-in. by 2-in. cylinder, prepared with the A.F.A. rammer, is extremely useful, since the procedure is simple, the test is completed in a few minutes, and the figures obtained are sufficiently accurate to ensure that the green strength is within the limits giving good results in practice, as found from previous experience. This method, already widely used in America, has therefore been adopted for foundry control purposes by various British technical committees dealing with sand testing.

Seeking the Scientific Basis

Any scientific study of the properties of raw sands and of untried mixtures, however, must take account of the variation in properties caused by an alteration in the relative density, since the relative density to which moulds are rammed varies not only in different foundries using the same sands for similar purposes, but also in any given foundry preparing moulds by different methods, such as jolting, hydraulic squeezing or sand slinging. Both the A.F.A. and the B.C.I.R.A. cylinders may be rammed to any desired relative density, but in the case of the A.F.A. cylinder, this involves abandoning the procedure standardised for ramming the cylinder.

The dimension ratio, or ratio of length to diameter, of the cylinders used for determining compressive strength is of some importance, since it governs the distribution of stress in the cylinders when the load is applied, and thus determines the way in which they will collapse. The A.F.A. cylinder has a dimension ratio of 1 to 1, and the B.C.I.R.A. cylinder a dimension ratio of 2 to 1. In engineering testing generally, compression test-pieces with a dimension ratio of 2 to 1 have been widely adopted as being the most satisfactory, and they appear to be equally satisfactory in sand testing. The A.F.A. and B.C.I.R.A. cylinders do not give identical results when the same sand is being tested at the same relative density, and the ratio between the figures obtained with the two types of cylinder is not constant. It is necessary, therefore, to state that all results quoted in the present Paper have been obtained from B.C.I.R.A. cylinders 2.256 in. long by 1.128 in. diameter. The relative density of either type of cylinder is easily obtained, the weight of the cylinder in grammes being divided by its volume in cubic centimetres, which for the A.F.A. cylinder is 103 c.c., and for the B.C.I.R.A. cylinder 37 c.c.

How Compression may be Effected

When the sand in a cylinder is being compressed, the particles may move closer together, or small grains may be pushed into the spaces between larger grains, or elongated grains may move so as to have a larger area of contact with their neighbours. Even if the sand consisted entirely of spheres all of the same size, and all initially touching each other, it would in general be possible to compress them into a smaller space, since there are several ways in which similar spheres can be arranged to be all touching, and yet occupying different volumes. The relative density naturally increases during this compression, since the same amount of matter is forced into a smaller volume. The figure for relative density is not, however, completely satisfactory as a measure of the degree of packing of the sand particles. For example, a mass of M grammes of sand made into a B.C.I.R.A. cylinder and occupying a volume of 37 c.c. has a relative density of $\frac{M}{37.}$ If, now, the space between the grains is filled with water, the weight of water required being N grammes, the relative density of the cylinder is $\frac{M+N}{37}$ so that the relative density is increased, although the degree of packing of the sand grains is exactly the same as before. It is important, therefore, to realise that there may be appreciable differences between the relative density and what may be termed "pack density." This "pack density" may be easily obtained from the relative density as ordinarily determined, by calculating the weight of water present, subtracting it from the total weight of the cylinder, and using the weight of dry sand to find the degree of packing. All relative densities quoted in the present Paper have been calculated in the ordinary way, that is, including the weight of any water present.

Results Obtained

The results of crushing these cylinders are influenced by the degree of perfection of their form, and the presence of any fine fins projecting from the ends leads to results which are too low. Various types of machine are used to crush green-sand test cylinders, some using direct loading and some using springs, and the operation presents little difficulty. One precaution

* Paper presented on behalf of the Institute of British Foundrymen to the 17th Annual Conference of the French Foundry Technical Association. The author is chief chemist to English Steel Corporation, Limited.

which should always be taken, however, is to ensure that the load is applied along the axis of the cylinder. This is best done by fitting some type of ball or universal joint between the top of the cylinder and the rod which applies the load. In some cases it is necessary to fit such a joint at the bottom of the cylinder also. Neglect of this precaution often leads to low results being obtained in crushing such cylinders. A yield or partial collapse is often observed at a somewhat lower load than is required to make the cylinder collapse completely. This yield point is of significance, but a good deal more work is required before its exact effect on the behaviour of sand mixtures in the foundry is known with accuracy.

It is well known that the green-sand strength of a sand increases rapidly when it is compressed,

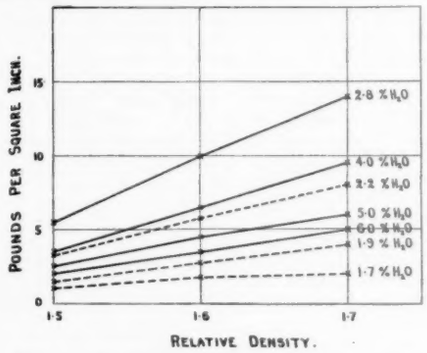


FIG. 1.—INCREASE IN GREEN STRENGTH WITH INCREASING RELATIVE DENSITY FOR SAND MIXTURES WITH DIFFERENT WATER CONTENTS.

whilst if water is progressively added to a sand mixture, the green strength rises rapidly to a maximum, and then gradually falls. Any complete testing of a sand must, therefore, include the effect of these factors.

TABLE I.—*Green Strength of King's Lynn Red Silica Sand with 3.5 per cent. Bentonite.*

Water content, Per cent.	Green strength, lb. per sq. in.		
	Relative density 1.5	Relative density 1.6	Relative density 1.7
1.7	1.00	1.75	2.00
1.9	1.50	2.75	4.00
2.2	3.25	5.75	8.00
2.8	5.50	10.00	14.00
4.0	3.50	6.50	9.50
5.0	2.50	4.50	6.00
6.0	2.00	3.50	5.00

A simple illustration covering only a limited range of the possible variations is shown in Table I, which gives the properties of a mixture of King's Lynn red silica sand milled with 3.5 per cent. of its weight with bentonite. This sand has grains of a medium size and sub-angular in shape, its chemical analysis being as follows:—SiO_2, 95.60; Fe_2O_3, 0.57; Al_2O_3, 3.03; CaO, nil; MgO, 0.1, and loss on ignition, 0.68 per cent.

The grains of this sand possess a thin film of tightly-held clay bond which is not easily removed by washing. This thin film of clay, and the partly angular shape of its grains, both make the strength obtainable when a given amount of additional bond is milled with this sand greater than if the grains were of the same size, but rounded in shape and having no residual surface bond. The mechanical grading of the sand before mixing with bentonite is given in Table IA.

Influence of Water Content

The test results are shown graphically in two different ways in Fig. 1 and Fig. 2. Fig. 1 illustrates the increase in green strength with a rise in relative density, for mixtures containing different amounts of water. As, however, the strength falls on both sides of the optimum water content, the graph is somewhat confusing. Fig. 2 presents the same facts in a different way, and illustrates the change in green strength as the

TABLE IA.—*Sieving Tests on King's Lynn Silica Sand.*

B.S.I. Sieve No.	Nominal size of aperture (side of square).	Percentage remaining on sieve.
	In.	
16	0.0395	0.1
22	0.0275	0.1
30	0.0197	2.0
44	0.0139	24.5
60	0.0099	25.0
100	0.0060	37.2
150	0.0041	5.0
Silt (between 0.01 and 0.10 mm.		1.9
Clay (less than 0.01 mm.) ..		4.2

water content is increased, for three different relative densities. It shows that the green strength at low water contents is low, and that as the water content is increased the strength rises rapidly to a maximum, then gradually falls. It also shows that at high water content the rise in green strength produced by an increase in relative density is much less than at lower water contents. The results of a complete examination of such a sand mixture could be represented by a larger number of curves covering a wider range of relative density and of water content, the range in each case being limited merely by the physical possibility of preparing self-supporting cylinders.

Influence of Time

When the green strength of sand mixtures is being determined, the cylinders should be crushed immediately after being prepared, since the time of standing has an important effect upon the results obtained. This effect is illustrated in Table II, which gives the green compressive strength of a mixture of King's Lynn red silica sand with 3 per cent. of bentonite, after being allowed to stand for different

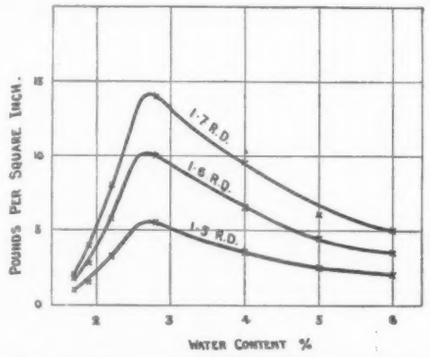


FIG. 2.—CHANGE IN GREEN STRENGTH WITH VARYING WATER CONTENT FOR SAND MIXTURES OF DIFFERENT RELATIVE DENSITIES.

periods. This Table shows that when such cylinders are allowed to stand in the laboratory, the green strength rises steadily for a few days, until it becomes approximately constant.

The water content of the original mixture was 3 per cent., and this fell steadily until at the end of the period indicated it was approximately 0.55 per cent. Water was evidently being lost to the atmosphere by evaporation from the outside of the cylinders, the final figure representing an equilibrium between the water in the outer layers and the tension of water vapour in the atmosphere. The relative humidity of the air in the laboratory varied between 60 and 80 per cent., and on further standing the strength of the cylinders varied a little accordingly. The equilibrium is influenced by the size of the grains, by the nature and amount of the clay, by the prevailing temperature and by the relative humidity of the atmosphere.

Some of the cylinders were dried after standing for different times, and the results of crushing the dried cylinders, given in Table III, show that the strength obtained on complete drying is practically constant. This dry strength is established by the original water content of the milled sand, so that for a given sand mix-

TABLE II.—*Green Strength in Compression of King's Lynn Red Silica Sand with 3 per cent. of Bentonite Allowed to Stand Before Crushing.*

Green strength. Lb. per sq. in.	Time of standing.	Water content. Per cent.	Average temperature of surroundings. Deg. C.
6.8	0	3.0	17
7.1	7 min.	—	17
9.9	1½ hrs.	2.33	17
11.8	4½ hrs.	1.44	17
15.9	1 day	0.88	16
22.3	2 days	0.73	16
22.2	3 days	0.62	16
22.9	4 days	0.54	14
22.2	5 days	0.53	13
23.3	7 days	0.55	13
22.0	8 days	0.57	12
22.0	9 days	0.56	12

Original water content 3 per cent. Relative density 1·6.

ture it is the same whether the time taken to dry it completely is long or short, in exactly the same way as the heat evolved by the combustion of 12 grammes of carbon to form carbon dioxide is the same whatever the stages of the oxidation may be.

TABLE III.—*Dry Strength in Compression of King's Lynn Red Silica Sand with 3 per cent. of Bentonite. Allowed to Stand Before Baking.*

Dry strength. Lb. per sq. in.	Time of standing before baking.
40.4	5 minutes
40.4	35 minutes
41.4	1 hour 5 minutes
39.4	2 hours 10 minutes
41.4	1 day
39.4	2 days
40.4	3 days
41.4	4 days

Heated to 200 deg. C. for 1 hr. Crushed at 45 deg. C.

There is no need to dwell on the importance in the foundry of this change in strength of green-sand mixtures on standing. To mention one aspect only, the successful manufacture of steel castings in green sand depends in some cases on the low strength of the mould which minimises the occurrence of hot tears, an advantage which may be largely lost if the strength of the sand increases considerably.

(To be continued.)

Catalogue Received

Surface Hardening of Cast Iron. A folder received from the Shorter Process Company, Limited, of Celtic Works, Savile Street East, Sheffield, 4, not only describes the Shorter process for the surface hardening of steel, now extended to embrace cast iron, but also includes a large number of photographs of the special machines they have designed and marketed for carrying out the process. When treating cast iron it is essential that the material contain some combined carbon, but immaterial whether it is alloyed. The process, which involves the use of a blowpipe, is the essence of simplicity, and quite often existing machines can be adapted for either the actuation of the piece to be treated or the moving of the blowpipe.

International Meehanite Metal Research Institute

ANNUAL CONFERENCE 1938

The annual conference of the licensees of the International Meehanite Metal Company, Limited, was held on June 2 and 3 in Glasgow. This being the first occasion that the meeting has been held out of London. Mr. Oliver Smalley, chairman of the Meehanite Metal Corporation, presided, and was supported by Mr. John Cameron and Mr. N. E. Rambush, directors of the company.

About 40 persons attended, representing Ashmore, Benson, Pease & Company, Limited; J. Blakeborough & Sons, Limited; Butterley Iron Company, Limited; Ealing Park Foundry Company, Limited; English Electric Company, Limited; Cameron & Roberton, Limited; G. M. Hay & Company, Limited; John Harper (Meehanite), Limited; Ransomes & Rapier, Limited; Winget, Limited; Delattre et Frouard; Glenfield & Kennedy, Limited, and the staff of International Meehanite Metal Company, Limited.

The CHAIRMAN, in opening the conference, specially welcomed the representatives of those licensees who had joined since the last meeting, and expressed his pleasure at being able to meet the representatives of United Kingdom and Continental licensees. He referred to the developments which had been made in the Meehanite organisation during the past year, and made special mention of the progress of the Australian Company and the extension of the use of the Meehanite process in that country and in New Zealand. He also intimated that it had been arranged to hold a conference for the convenience of Continental licensees, next month in Switzerland. The meeting discussed about a dozen Papers dealing with various technical matters of interest to licensees. In the afternoon the company visited the foundries of Messrs. Cameron & Roberton, Limited, Kirkintilloch.

Annual Dinner

In the evening the annual dinner of the Institute was held in the Grosvenor Restaurant, Glasgow, when Mr. Smalley presided, and was accompanied at the high table by the directors; Mr. H. Gardner, of Glenfield & Kennedy, member of the entertainment committee; Professor W. Kerr, D.Ph., of the Royal Technical College, Glasgow; Mr. Daniel Sharpe, chairman of A. & W. Smith, and director of Saracen Foundry, Glasgow; Mr. V. C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL, as guests.

After the loyal toast, MR. HENRY GARDNER welcomed the company to Scotland, and expressed the hope that they would all find the visit not only instructive, but also enjoyable. He hoped they would all take the opportunity of visiting the exhibition and examining the various exhibits.

MR. D. SHARPE, in the course of an interesting speech, told the company something of the early history of Meehanite in Britain, how, during a visit to the States in 1925, he learned of the Meehanite process and made arrangements to introduce it in this country, and, in fact, was responsible for the issue of the first British licence to the firm of G. M. Hay, of Glasgow. He is now a user of Meehanite in one of the companies in which he is interested.

PROFESSOR W. KERR gave a short talk on the use of cast iron in engineering work. He explained how, with increased service demands, the old cast iron was found unreliable and engineers were compelled to turn to steel castings and led to believe the day of cast iron was at an end. He stated that engineers were mainly concerned with stress distribution and the metallurgists with structural composition. The real facts of stress distribution in engineering structures and in machine parts was not fully understood, and on that account it was a matter of necessity to use stronger and more certain materials of definite engineering properties to permit of design with a clear factor of safety. Engineers had redesigned things to suit steel, and now it would be necessary to start all over again, because of the special high duty irons, such as Meehanite. The claims for this material were in many respects startling; it was surprising to find a cast iron with a definite modulus and elastic limit and with a fatigue value 60 per cent. of the ultimate. He had had the opportunity of proving that some of the claims made for the material were justified, and hoped soon to be able as the result of investigations just started to prove that the material had the same high degree of excellence in the still larger, but so far little explored, field of creep properties at higher temperatures. If this should be possible and the fatigue value of 60 per cent. of the ultimate confirmed, he considered that a most valuable aid to the engineer had been provided. He thought the Institute should do more propaganda in bringing to the notice of the engineer the merits of Meehanite, as the old idea of cast iron being a weak and unreliable material still persisted in the minds of engineers, and they were afraid to use anything of the cast iron type of metal for heavy duty.

MR. V. C. FAULKNER also spoke and referred to the progress of the Institute and the gradually increasing realisation of the merits of Meehanite by the engineering profession. He himself had been in many Meehanite foundries and was quite content to accept the claims which are made for the material.

The CHAIRMAN proposed a vote of thanks to Mr. John Cameron, who as chairman of the entertainment committee had been responsible for the arrangements for the conference.

MR. J. CAMERON, in replying to the vote of thanks, expressed the pleasure of the Scottish Licensees at having the opportunity of receiving the members of the Institute in Glasgow. He said it was always a great pleasure to be at the annual meetings and to meet the chairman, Mr. Smalley, and to hear his latest views. He was an enthusiast and always managed to instill some of his enthusiasm into the other members. He asked them to drink to the toast of the chairman. The toast was accorded with enthusiasm to the accompaniment of the singing of "He is a Jolly Good Fellow." The following day another 14 technical Papers were discussed, as well as other matters of interest to the licensees. In the afternoon the party travelled to Kilmarnock and visited the works of Glenfield & Kennedy, Limited, when the conference officially ended. The majority of the members visited the Empire Exhibition on June 4 before returning home.

Cleansing Provisions of Factories Act

The Secretary for State has issued an order (1938 No. 487) Factories, under the Factories Act, 1937, known as the Factories (Cleanliness of Walls and Ceilings) Order, 1938. It provides that Paragraph (*c*) of Section I of the Act shall not apply to the classes or descriptions of factory or parts of factories specified in the First Schedule to the Order, which includes in Part A blast furnaces, iron mills, chemical works and gas works, stone, brick and cement works. Part B includes shipbuilding works, engineering works, foundries (other than brass), electric generating and transformer stations. Provided that the said paragraph (*c*) shall continue to apply—(i) As respects factories or parts of factories specified in Part A of the Schedule, to workrooms in which the amount of cubic space allowed for every person employed in the room is less than 500 cub. ft.; (ii) as respects factories or parts of factories specified in Part B of the schedule, to workrooms in which the amount of cubic space allowed for every person employed in the room is less than 2,500 cub. ft.; (iii) to engine-houses, fitting shops, messrooms, cloakrooms, lavatories, and sanitary conveniences; and (iv) to such parts of walls, sides and tops, of passages and staircases as are less than 20 ft. above the floor or stair. Copies of the Order may be obtained from H.M. Stationary Office, Adastral House, Kingsway, London, W.C.2. (Price 1d.)

Elliptical Blast Furnaces

In a recent discussion by M. PAWLOW of the question of the construction and efficiency of large blast furnaces, published in "Stal," the author referred briefly to furnaces with an elliptical cross-section. The first furnaces with other than a circular section, *i.e.*, a rectangular or elliptical one, were proposed and built about 1860. An early furnace of this type is, in fact, still in operation at the Teplogorsk Iron and Steel Works in the Urals; it was thought that a greater throughput could be achieved in an elliptical furnace as compared to a circular furnace with the reduced blast available. Pawlow states that nearly 20 of these furnaces were to be found in the Urals in the last two decades of the 19th century. Wherever circular furnaces of equal height replaced old elliptical ones, it has been found that the former, with the same fuel consumption, gave the same output as an elliptical furnace with 1½ times the capacity of the circular furnace. This fact, together with the greater cost and difficulties in construction of the elliptical furnace, naturally led to preference being shown for the circular furnace.

Recently, renewed interest has been shown in elliptical furnaces following investigations by

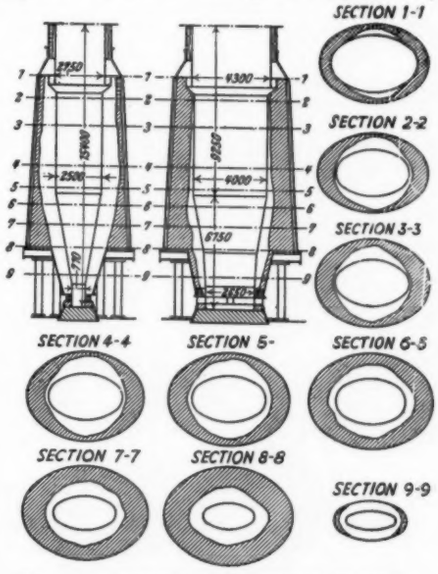


FIG. 1.—SECTIONS OF ELLIPTICAL FURNACE.

various blast-furnace engineers in the Urals, notably I. A. Ssokolow, carried out in view of the not entirely successful campaign of the first of the two large furnaces at Magnitogorsk. Ssokolow suggested that the reason was scaffolding in the 7.62-m. dia. furnace which could be avoided by building a large capacity furnace with an elliptical cross section equal in area to that of the circular furnace. Pawlow rejects this proposal and on the basis of much data analyses the conditions of operations and general efficiency of elliptical furnaces. He does not deny that the elliptical furnace is better than the rectangular one in which very pronounced scaffolding may be obtained, especially if the furnace has been subject to much wear, but the difference between the two is only one of degree for the elliptical furnace is subject to exactly the same drawbacks as the rectangular one.

This is shown by the sections through an elliptical furnace at Nishny-Solda, shown in Fig. 1. At the time of its construction this furnace was one of the best of its type; the bosh was armoured, the stack encased in cast iron and the throat built with a riveted elliptical bell. After 15 years only the outer section was elliptical, while in the interior the axes had become progressively more equal to each other, indicating the natural section was circular.

Castings versus Forgings

By D. CLARKE (Commonwealth Steel Co,, Ltd., Australia)

There are numerous engineers and users generally who regard steel castings with such suspicion and misgiving that they would not dream of employing them when forgings are alternatively available. Many metallurgists, also, regrettably some of no little repute, hold similar views, and while the engineer may be pardoned for his opinions, like consideration can hardly be extended to a metallurgist who is obviously just a little out-of-date on matters that should more intimately concern him than the engineer. Such a viewpoint arises from an indubitable bias or ignorance, however one likes to call it, and takes no cognisance of the developments that have taken place in recent times in the technique and practice of the modern foundry.

From close contact over a period of years with nearly all phases of steelworks operations and those of the allied industries, it seems clearly indicative that the foundry in the past has been

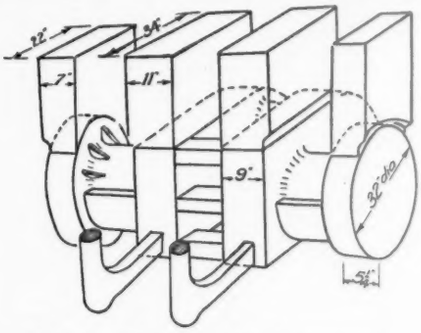


FIG. 1.—CAST CRANKSHAFT WEIGHING 107 CWTS.

Risers: Flange 22 in. × 7 in. × 24 in. high; crankweb, 34 in. × 11 in. × 24 in. high.

Runners: Two 3 in. downgates; two 4 in. × 1½ ingates. Cast with tundish. Eight ⅝ in. brackets around each flange. Three binding strips, 4 in. × 4 in.

wont to be regarded as the Cinderella, and the activities of technicians have not been directed to its problems in anything like the same degree as on those peculiar to the other branches.

This, happily, is in process of change, and to such purpose that, the writer believes, if an analysis of failures of both castings and forgings were made in respect to marine, railway or general engineering, it would overwhelmingly reveal that more forgings fail in service than castings.

Initial Training

In so far as the various callings in the engineering trades are concerned, it has been the practice of some employers when choosing boys as potential craftsmen, to select the brightest for fitting, turning, patternmaking, etc., and send the others to the foundry to be apprenticed to moulding as being the least important. Never was there a greater mistake. Every job brings to the moulder its own problems of gating, risering, etc., and considerable thought and planning are required on his part if a casting is to be secured that will beget the approbation and confidence of the purchaser. Indeed, it is not over-stating the case of the moulder to say that no trade should command a higher standard of intelligence than that of the foundry, for a first-class moulder must indeed be a craftsman in the highest sense of the term.

The adequate training of apprentices at the technical school or college and on the plant is a problem the importance of which cannot be exaggerated. If technical institutions are to perform the highest service to students apprenticed to the foundry trade, they should concern themselves more with the theoretical than the practical by teaching methods of calculation, drawing, something of the properties of iron and steel, a study of moulding sands and methods of testing, and all the "why's" and "wherefore's" of moulding. Practical training should be solely the function of the employer.

In Australia it has been found that the practical method producing by far the best results is to place a highly-skilled man or men in charge of the apprentices. His sole job is to supervise their work and generally act as guide, philosopher and friend. Such a scheme has proved to work out excellently and to the mutual advantage of employer and trainee alike.

Nevertheless, whatever may have been the sins of omission or commission in the past, there are many evidences that the alert and progressive

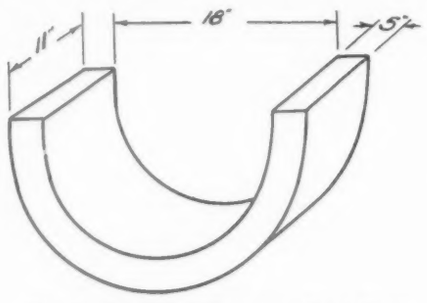


FIG. 2.—CAST-IRON CHILLS IN DRAG HALF OF OUTSIDE JOURNALS.

foundry is now reaping the reward of much patient endeavour, and increasingly castings are found to be successfully supplanting forgings in divers branches of engineering. Nor does there seem any reason to doubt that this will continue until, one day, something approaching the true dividing line will be reached.

An Outstanding Example

One example might be cited where in Australia a casting was supplied in lieu of a forging performing an important function. Towards the end of 1933 the M.V. "Port Fremantle," while *en route* from London to Sydney, fractured one of her crankshafts, weighing approximately 5¼ tons. Upon arrival of the ship at the latter port, the company with which the writer is associated was approached to supply a replace forging urgently. Since there was an understandable urge on the part of the owners to clear the ship with the minimum delay, it was suggested that, while perfectly willing to undertake the forging, a casting could be furnished more quickly, and one guaranteed to give service in every respect equal to any product of the forge.

The difficulty was that, as is well known, castings for this purpose are prohibited under Lloyd's rules, and the matter was on that account given the more earnest consideration. Eventually, however, it was mutually agreed that Lloyd's headquarters be approached with full details of the proposition, and in a surprisingly short space of time a cable was received from London acceding to the substitution of a casting, with the proviso that it be replaced by a forging upon arrival of the ship in the Motherland. With so much depending upon what was regarded as a somewhat revolutionary step, the method of manufacture was carefully examined, and particular attention paid towards ensuring the solidity so essential for a job of this kind.

Fig. 1 shows the method employed in moulding and running, and Fig. 2 the cast iron chills inserted in the drag-half of the journals. That the risering was more than ample can be seen from Fig. 3, exhibiting a section through a crank web riser. In addition, an inspection hole was drilled through the centre of the crankpin, but no trace of cavitation or unsoundness was revealed.

Heat-Treatment and Testing

Having proved the casting thus far satisfactory, the next step was the refinement of the microstructure. It is well known that effective heat-treatment of any casting or forging becomes more and more difficult with increasing mass. The treatment, therefore, of a job of this

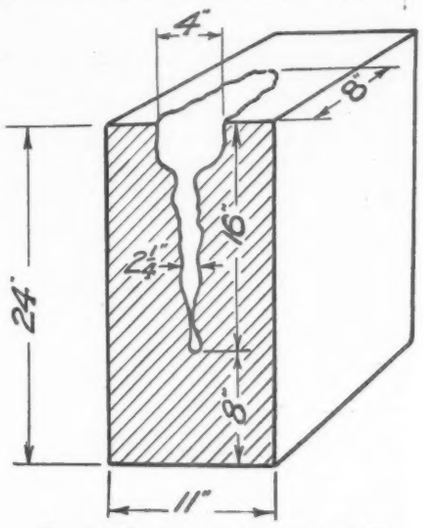


FIG. 3.—SECTION THROUGH ONE OF THE RISERS ON THE CRANKWEB.

section could not be lightly regarded, if the best results were to be secured and the crankshaft was to respond successfully to the service required of it.

The physical tests given below were taken from bars attached to the casting and broken under Lloyd's supervision. They clearly disclose the measure of success attending this phase of the manufacture.

	Position 1.	Position 2.
Yield, tons per sq. in. ..	19.1	21
Ultimate stress	32.4	33.1
Elongation, per cent. ..	28.0	28.3
Reduction in area, per cent.	42.8	41.6

The test-bars were 0.798 in. diameter by 3 in. between gauge points, and the Izod impact test was 30 ft.-lbs. average.

Microstructures

Further evidence of the effectiveness of the heat-treatment was obtained by microscopic examination. Fig. 4 shows the structure after preliminary heat-treatment, Fig. 5 at the intermediate stage, and Fig. 6 at the completion and before presentation for official tests. As the value of these micrographs can best be assessed by comparison, Fig. 7 reveals the structure of the fractured forging, which was produced, incidentally, by one of the most famous Continental manufacturers.

For a casting of such section heat-treated without quenching, the tests are eminently satisfactory, whilst the microstructure is as nearly perfect as it is possible to obtain, and in distinct contrast to the markedly inferior structure of the forging.

Upon arrival of the ship in England, the crankshaft was taken out and carefully inspected by Lloyd's experts, who had all the facts before them in respect of tests, micro-examination, etc.

As a result it was decided to re-install the casting, and the writer believes it will be intact when the vessel completes her life's journey and passes by way of the shipbreakers to a temporary resting place in the yard of some or other scrap merchant. Incidentally, it might be stated that this is the only cast-steel crankshaft placed in any ship built under Lloyd's supervision.

This example is but one among others where in Australia a foundry product has successfully supplanted a forged one, but it is concrete evidence that the foundries in the Commonwealth are in step with those in other parts of the world, where slowly but surely their products are encroaching upon what was formerly the exclusive prerogative of the forge.

FIG. 4.—MICROSTRUCTURE OF CAST STEEL CRANKSHAFT AFTER PRELIMINARY HEAT-TREATMENT. × (PROBABLY) 500.

An American Development

Little more than two years ago the writer was privileged to visit an American foundry, to wit, that of the Campbell, Wyant & Cannon Company, of Muskegon, Michigan, and here witnessed a most interesting and important development, also connected with cast crankshafts. In this case, however, they were not of steel, but of nickel-chrome-molybdenum iron, which had been approved of and accepted by the American Admiralty for diesel motors employed in their service. The base metal is drawn from a cupola, added to the alloys which are electrically melted, then the whole charged into an electric furnace and superheated to the temperature desired. This alloy iron is stated to be unexcelled for bearings and has a high factor of safety. The crankshafts produced weigh between 85 and 1,450 lbs., the largest being 110 in. long, while the tensile strengths range from 26.8 to 38 tons per sq. in., and the Brinell hardness from 262 to 302. Fig. 8 illustrates a few of these high-grade castings.

FIG. 6.—THE CRANKSHAFT AFTER FINAL HEAT-TREATMENT. × (PROBABLY) 100.

Cast Crankshafts

It must candidly be admitted, however, that no development of steel castings in substitution of forgings excels in importance that of the Ford "V-8" crankshaft. Here, indeed, is a revolutionary step and one that has been justified and amply proved by the successful performances of these castings in all parts of the world. And if one correctly interprets the writing on the wall, the next step may be the substitution of cast iron for cast steel in crankshafts, camshafts, and certain other components. And why not? Cast steel exhibits better damping properties than forged steel and cast iron than cast steel, so that when engines are suitably designed for the former material it will probably be found that the manufacturers of mass-production cars will take advantage of the economies offered by high-duty iron castings.

In the field of general-purpose cast irons, one of the most notable developments in the world to-day is that introduced by Mr. Oliver Smalley, British Consul at Pittsburgh, U.S.A., in the series of irons known as "Meehanite," and from what the writer has seen and learned of the properties of these irons it is reasonable to assume that some of the grades at least are capable of extended application in many spheres of engineering.

Fundamental Differences

In considering briefly the basic differences between castings and forgings, it can be stated that a well-designed steel casting fashioned according to the best accepted moulding practice does not possess two very serious faults liable to be associated with forgings, namely, axial and directional weakness.

When an ingot for forging is cast into a metal mould, the steel freezes progressively from the wall inwards and the bottom upwards, expelling into the still liquid metal all the highly infusible non-metallic bodies which finally align themselves along the greater part axis as being the final portion to solidify. Such concentrated impurities in the ingot constitute a generic weakness also present in the finished forging and this weakness is eliminated only in those cases when provision is made for a hole being bored completely through the axis. The size of the hole necessary to remove this axial zone of impurities in their entirety depends upon the ratio of forge work from ingot to finished product.

On the other hand, sand being a poor heat conductor produces in a casting a slower rate of freezing and, as a consequence, the non-metallic impurities, colourfully and expressively described by Brearley as "dirt," are more evenly distributed across the section and are thus less harmful.

The second disability a forging may suffer from is directional weakness. When a straight shaft is forged from an ingot it may be regarded as representing a bundle of fibres such as the strands in a wire rope. On this assumption, therefore, it will be obvious that as mechanical manipulation proceeds, these fibres become more and more attenuated and, whilst the physical properties are improving to a point, in a lengthwise direction, it is at the expense of those at right-angles to the line of work. If this is admitted, then it must also be agreed that when the forging ratio exceeds a certain value the transverse properties are increasingly impaired, so that it may only require a moderate stress unfavourably imposed to produce premature failure. *Castings exhibit no such directional weakness.*

Awaiting Improvement

Nevertheless, despite all the advances that have been made in steel-foundry practice during the past few years, much yet remains to be done, and this is at least as true with respect to heat-treatment as any other phase of the operations. Indeed, in quite a number of jobbing foundries throughout the world a considerable amount of their work is despatched without any attempt at heat-treatment whatever, the castings simply being delivered and used in their weak "as-cast" condition.

This unwise procedure may provide one reason why certain users in the past have been wont to look askance at the products of the steel foundry, and it is fairly certain that the unsatisfactory and irregular behaviour of many castings in the machine shop and ultimately in service has its origin in the pursuance of this malpractice.

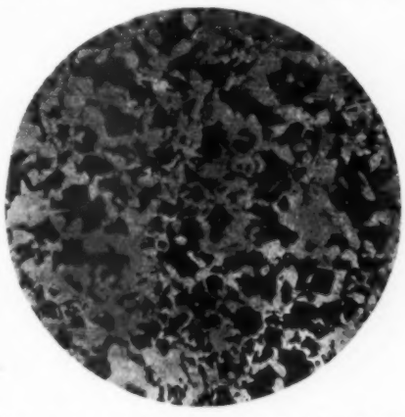


FIG. 5.—CAST CRANKSHAFT FOR M.V. PORT FREMANTLE AFTER SECOND HEAT-TREATMENT. × (PROBABLY) 100.

More Intelligent Heat-Treatment Advocated

In attempts to offer some sort of defence for such, perhaps, reprehensible procedure, it has been stated that there are many forgings in use which likewise have never been subjected to any heat-treatment. While neither practice can be condoned, forgings have at least this advantage, that the original cast structure is removed by mechanical work, and if the proper finishing temperature is observed, then despite the fact that forging stresses of varying magnitude will be present which can only be removed by heat-treatment, or in part by time, a reasonably good structure may be obtained. It should not be inferred or assumed, however, that if castings are submitted to heat-treatment one's hands may be complacently folded in a belief that all is well. If heat-treatment be worth while, it must be efficiently performed, as a badly heat-treated casting may well be worse than those severely left alone.

FIG. 7.—CONTINENTAL FORGED STEEL CRANKSHAFT WHICH FRACTURED DURING SERVICE. × (PROBABLY) 500.

One cause of ineffective heat-treatment can be traced to the heterogeneous variety of jobs

frequently comprising what is described as an "annealing" charge. The function of heat-treatment is of course to remove all traces of the weak Widmanstätten structure produced by more or less unavoidable selective solidification, and to replace it by one exhibiting greater toughness and better suited to the vagaries of service.

Since the time to effect this transformation is governed by the thickness of the section, it is obvious that when dealing at the same moment with castings varying widely in thickness, those of thin section, in order to satisfy the requirements of those of heavier mass, may be kept too long at the required temperature and therefore be subjected not only to undesirable grain-growth, but excessive oxidation.

If the heat-treatment is to be reasonably efficient, then under such circumstances the remedy is to segregate the charges into batches of somewhat similar section and/or bulk.

Concerning the actual heat-treatment operation itself, it was the case not so long ago, where a single treatment only was given, that this comprised an annealing consisting of heating to above the critical range and then slowly cooling in the furnace. No modern technically-controlled foundry to-day would prescribe such treatment unless in certain limited instances where exposure to the atmosphere of castings of intricate design from high temperatures would cause undue warping.

For the purpose of ensuring enhanced physical results statically and dynamically, small grain size is a *sine qua non*, to obtain which, without having recourse to quenching, the casting should be normalised either in lieu of, or additional to, the annealing.

Turning now to the question of mechanical tests prescribed by certain authorities and controlling bodies for the acceptance of steel castings, it would almost appear as if they had been born in an environment of fear emanating from the days when the foundry product was regarded as a necessary evil and when employed, one devoutly hoped for the best. Moreover, the requirements to be fulfilled in respect of some specifications seem to indicate a lack of co-operation between metallurgist and engineer which is unfortunate, considering that each in his respective sphere is constantly aiming at an ever-increasing efficiency.

To meet the conditions covering acceptance of steel castings required by the Australian and New Zealand Railways, subtended are details of the physical tests formulated:—Yield 16.0 tons per sq. in. (min.); ultimate stress 30.0 tons per sq. in. (min.); elongation in 2 in. 24.0 per cent. (min.); reduction in area 35 per cent. (min.); Izod impact 20.0 ft.-lbs. (min.), and bend 1 in. dia. to 90 deg. (min.) without cracking.

These tests, perhaps somewhat more exacting than called for in some other parts of the world, are typical of the increasing demands on the foundry, and the question may legitimately be asked, are they desirable or necessary?

In the opinion of the writer, all that is material apart from the approval of the chemical analysis, coupled with an examination of the casting itself, is a hardness determination to gauge the strength, fracture tests from suitable pieces cast-on, to assess not only the value of the heat-treatment by viewing the fracture but also something of its freedom from brittleness and resistance to impact, finally, a typical section to investigate by no means the least important aspect of all, namely, the micro-structure. With present-day methods of preparing and polishing samples for microscopic work, this latter examination can be completed very quickly, and at less cost than the provision and preparation of any of the traditional bars for physical tests.

In providing test-bars cast on the job itself, due consideration is not always given to the fact that, in the case of certain designs, a definite weakness may be produced at the point where the bar is located on the casting. This is one undesirable feature arising from a strict adherence to this practice.

On the other hand, assuming the casting of a separate block is permitted, can it truly be held representative of the casting? It is, of course, possible to make it so within limits that may be regarded as close enough, but the alternative method herein suggested for the appraisement of a casting from every point of view that matters would overcome all possible disabilities arising from the provision of the usual standard tests.

The next technical development designed to check the efficiency of castings that will come in the effluxion of time will be the test for internal soundness by X-rays. A certain amount of this work has already been done in Australia, but if what has been so far achieved is typical of that elsewhere, much remains before this line of inquiry will be employed except on highly important work falling within the ambit of the present-day equipment. Until such time arrives, the exploration for internal cavitation when desired will continue, as at present, by drilling inspection holes at vital points.

Concerning developments in the Antipodes, in contradistinction to the revival of the converter process in Great Britain fostered by the exploitation of the soda-ash process, the trend is rather towards the greater development of electric steel. This does not mean that converters are being eliminated, but rather that when new units are required to supplement production, electric arc furnaces are being installed. For large castings recourse is, of course, made to the acid or basic open-hearth processes.

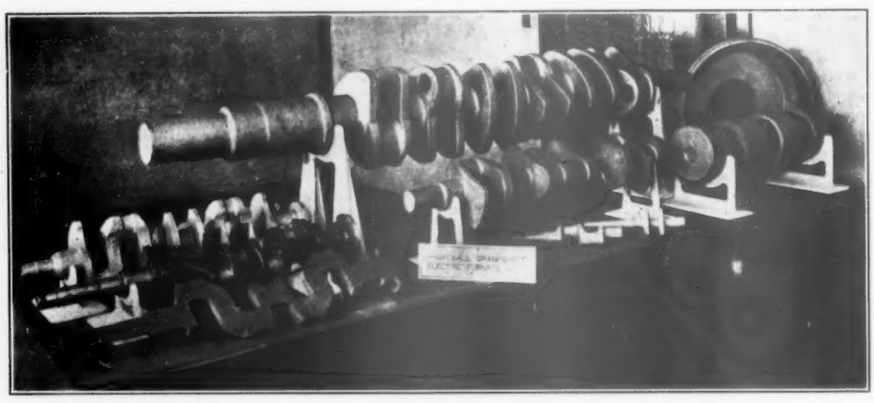


FIG. 8.—ELECTRIC FURNACE SUPERHEATED ALLOYED DIESEL ENGINE CASTINGS.

Notes from the Branches

Birmingham Branch.—Mr. L. W. Bolton, Senior Vice-President of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, has been appointed President in succession to Mr. W. J. Molineux, whose untimely death only a short time after his election to the office was recorded in a recent issue of the JOURNAL. Mr. Bolton, who thus enters upon his Presidential duties in melancholy circumstances, was assured of the hearty support of the Council and members at an extraordinary general meeting of the Branch held on May 30, at which Mr. H. J. Roe took the chair. Mr. A. Tipper, Junior Vice-President, was asked to serve in the senior position and Mr. N. C. Blythe was elected to the junior office.

The memory of Mr. Molineux was honoured by the members standing for a moment in silence, and sincere sympathy was expressed with his family. Tributes to his personal qualities and the service he had rendered to the Institute were paid by Mr. G. W. Brown and Mr. D. H. Wood.

Mr. Roe was thanked for valuable services rendered during his term of office as President, which had been extended owing to the death of Mr. Molineux.

Sheffield Branch.—A competition for apprentice patternmakers, which is believed to have been the first held in England, took place on May 28 in Sheffield. It was arranged by the Council of the Sheffield Branch of the Institute of British Foundrymen, and was open to all apprentice patternmakers in Sheffield and district under the age of 22 years. There were 37 entrants from foundries located in Sheffield, Doncaster, Chesterfield and Chapeltown. The examination was held in the patternshops of English Steel Corporation, Limited, and Hadfields, Limited, by special permission of those companies. The competitors were supplied with a list of necessary tools which they brought with them, whilst timber, nails, screws and dowels were kindly provided by the companies mentioned.

A full-sized, dimensioned drawing of a small bracket, which could be made equally well in iron, steel or non-ferrous metals, was supplied to the competitors, the number of castings required being stated as 50. Each competitor was allowed to choose his method of moulding, and adopt his own contraction allowance. The time allowed for making the pattern was four hours, and competitors were informed that a well-made pattern which was not finished would stand as good a chance as a pattern which was finished but badly made.

Although all competitors were making patterns for the same kind of bracket, the task was simplified for those under the age of 18 years. In addition, an age allowance was given to all competitors under the age of 21.

The judges appointed for the competition were Dr. C. J. Dadswell (foundry manager of English Steel Corporation); Mr. G. Offiler (foreman patternmaker of Aurora Gearing Company), and Mr. C. E. Joynes (foreman patternmaker of British Thomson-Houston Company, Rugby). The judges had a very difficult task, as several of the patterns were extremely well made. The prizes were finally awarded as follow:—

1st Prize.—W. Swift, aged 19 (Davy & United Engineering Company, Limited, Sheffield).

2nd Prize.—D. Williams, aged 17 (Markham & Company, Limited, Chesterfield).

3rd Prize.—H. Roberts, aged 16 (Newton, Chambers & Company, Limited, Thorncliffe).

The money prizes, which were presented by the Council of the Sheffield Branch, were:—1st Prize, £5; 2nd Prize, £2; 3rd Prize, £1.

For Thursday, November 3, the Sheffield Branch has arranged a smoking concert, at which the judges and others concerned with running this competition will give an account of the competition and the work of the competitors.

The Foundry of Ruston & Hornsby, Limited, Lincoln

This foundry, which was recently thrown open for inspection by the technical Press, is an outstanding example of the intelligent application of modern methods of manufacturing for the production of an extremely wide range of castings. During the recession in the early 'thirties, an effort was made to concentrate the work of several foundries at the Spike Foundry. This served well enough for several years, but with the increasing demands placed upon it, a decision had to be taken as to whether some of the attached foundries should be reopened or whether an effort should be made to increase production per unit of floor space. The latter proposition was decided upon, even though it necessitated the performance of certain foundry operations in separate buildings, involving of course the question of "distance" in handling. Generally speaking, this last factor is reduced to the handling of the prepared oil sand from the core reclamation department to the core production shop, and to the transference of the castings from the moulding shop across a private road for fettling. The former is economically effected by a special petrol-driven dumping car, running on pneumatic tyres, the latter by telpher and wagon.

FIG. 1.—LARGE CORE-MAKING DEPARTMENT.

Because of its lay-out, a better appreciation of this foundry can be given by dealing with it geographically rather than by sequence of process. Thus it is proposed to describe the foundry under the following headings:—(1) Core production department; (2) main foundry department; (3) mechanised foundry department; (4) fettling department; (5) core-sand recovery section, and (6) patternmaking departments.

CORE PRODUCTION DEPARTMENTS

For reasons indicated it has been found advisable to develop two separate sections for this work, one dealing with the large, heavy type of cores and the other handling small and medium cores solely. In the heavy section all cores are made in a separate shop by girls in both natural-bonded and oil sands. Fig 1 illustrates the type of core made and the department. The shop is 150 ft. by 50 ft., served by a 3-ton overhead crane. Male labourers are provided for the heavy lifting work, but all production is executed by girls.

Drying is carried out by means of three drying stoves of Ruston & Hornsby manufacture fired by one "Acme" type firebox. The inlet flues are of original Ruston & Hornsby design and differ somewhat from orthodox, in order to ensure uniform drying throughout different parts of stoves. The whole production is on a genuine piece-work basis, each core being individually priced. It is believed that this is the only shop in the country where such large cores are made and finished entirely with female labour.

The light core shop arrangement and layout are outlined in Fig. 2 and illustrated in Fig. 3. This was one of the first, if not the first, attempt in this country to introduce rational mechanisation and organised production in what is essentially a jobbing, or at the best, a batch-production core shop. It will be seen that coremaking is carried out on cross-benches A by female labour, linked up with a roller conveyor B (specially built to minimise bumping), leading to a large-sized "Acme" continuous drying stove, C, on to which the cores are loaded for drying. This stove is capable of handling a maximum size of core of 5 ft. 6 in. by 20 in. by 20 in. At the discharge end of the stove the dried cores are unloaded on to another roller conveyor, D, which distributes them to the female core dressers and finishers. Finished blacked cores are loaded on to another roller conveyor E, leading to a second "Acme" continuous stove, F, for drying-off the wet blacking coating. In this case, of course, the cycle is of much shorter duration.

A roller conveyor system, G, also deals with the return of core plates to the coremakers. Experiments are being carried out with compressed asbestos, instead of cast-iron plates.

Incorporated in the finishing department is a section dealing with core assembly of individual cores into complete units, shown in Fig. 4. This is carried out in metal jigs and fixtures so that dimensional accuracy can be relied upon. In this way mould closing is simplified, the human element reduced to a minimum and subsequent machine-shop complaints of dimensional inaccuracies reduced to a minimum. Every core is subjected to inspection before being despatched to the foundry departments. Here, again, female labour is solely employed on all production work, and a similar piece-work system is in operation as for the large core shop.

A recent installation is a "Coleman" core-blowing machine (seen in left foreground of Fig. 3). This has proved eminently successful in the production of comparatively small batches of cores. For the variety of existing core-boxes to be dealt with, it was found necessary for Ruston & Hornsby to develop an entirely new type of back blowing plate. By this means it has been found possible to handle existing core boxes (both metal and wood) with an almost entire absence of alteration. It is obvious that incorporating complicated venting devices in thousands of existing core boxes would have made the whole proposition impracticable. With this special blowing plate, at least six different boxes can be in production at the same time without lengthy alteration to the machine or fixtures.

MAIN FOUNDRY DEPARTMENT

This department, illustrated in Fig. 6, consists of two large modern bays, each 600 ft. long by 50 ft. wide. No. 1 bay handles the heavy work and is served with six overhead cranes. Here is made the company's full range of medium and heavy Diesel engine housings, bedplates, flywheels, etc., and other general heavy work. At the present time ramming is carried out by the aid of two portable Sandslingers and two large bumpers, but Fig. 7 shows, in dotted lines, an entirely new arrangement in the course of erection. It is proposed to utilise a motive type Sandslinger for all No. 1 bay and part of No. 2 bay work. The main difficulty when considering this motive type Sandslinger arrangement was the length of the shop (600 ft.) and the long travel consequently necessary to refill with sand. This difficulty has been overcome by arranging for the Sandslinger to have sand available at any point along the length of shop. This machine, by the way, is already on site. Instead of the usual overhead hopper sand supply an overhead endless belt is provided for, running immediately over the slinger track. Plough points will be located at 8-ft. intervals; thus the Sandslinger storage hopper can be continuously filled at any point on the track during actual slinging and the arrangement also allows for trimming of the sand in the Sandslinger hopper.

Handling of used sand is to be effected by means of an underground return belt running the whole length of the shop, each moulding floor having its own knock-out. It was considered that a central knock-out station in such a long shop would cause too much disorganisation, particularly with the cranes. The return belt returns the sand to a cleaning and preparing plant. This latter consists of an existing complete No. 2 August Simpson mill, screen, magnetic separator and storage hopper, and a new installation of a No. 3 August Simpson mill and storage hopper. The mills discharge on to belt conveyors and then to a hopper having a rotary plate, and the sand is ploughed off at this point on to the main overhead distributing belt to the Sandslinger.

The small mill can be arranged for either mixing special facing sand or the bulk Sandslinger sand. When facing sand is made the swinging belt conveyor discharges into tubs which are then taken by overhead Morris telphers to any point in the shop. When this mill is engaged on the bulk sand the conveyor is swung so that discharge is delivered into the hopper feeding the Sandslinger belt. The whole of the sand distributing and preparing plant has been supplied by Augusts, Limited, of Halifax.

Drying Stoves

Mould drying is carried out by means of eight large stoves, located at convenient points round the shop, each heated by "Acme" type coke-fired, forced-draft fireboxes made by the Foundry & Engineering Company, Limited, West Bromwich. Four of the stoves are equipped with frictionless bogies supplied by the same firm. Even when fully loaded one man can move the bogie. Temperatures are controlled by Cambridge

recording thermometers on each individual stove. Practically every job is made in moulding boxes and consequently every care is taken in the drying operation.

A special feature in this department is the number of jigs and templates supplied to the moulders with every job for use in the coring-up operations. These are stamped with the pattern number and are, in fact, looked upon as part of the pattern tackle. The foot rule for core location purposes is a thing of the past in this foundry. By this means accurate locations are obtained, subsequent machining operations are simplified, and the production of interchangeable parts—so essential under modern conditions—ensured

Melting Plant

The melting equipment for the main foundry consists of two 9-ton per hr. cupolas and one 4-ton per hr. cupola. The two large cupolas are of the balanced-blast type and are blown alternate days. This ensures good condition, as each is carefully prepared and overhauled after each day's run. All three cupolas operate on a continuous tapping principle, shown in Fig. 8, being fitted with tilting spouts. The cupolas have only one tap-hole each, through which metal and slag is tapped, the slag being automatically separated in the cupola spout. This arrangement has been in operation on these cupolas for at least 18 years, and it is interesting to note that many cupolas in this country have recently been converted to the same system. The whole of the melting operations are controlled by a branch laboratory (actually located in the foundry) dealing only with foundry materials and problems. In this way up to the minute results are obtained, resulting in accurate control and uniformity of quality.

Over 100 tons of molten metal per day are handled in this section, and castings varying from 10 cwts. to 20 tons are produced. Metal is transported to the moulds both by overhead cranes and over a network of light rails on wheeled bogie ladles. As many as 130 cores are assembled in one mould for certain jobs, and 90 per cent. of the work produced is subsequently subjected to pressure-test after final machining. Fig. 9 shows a group of typical castings made in the heavy foundry.

The 4-ton per hr. cupola is used solely for special metals and is in operation every day. This ensures meticulous control and removes any possibility of contamination with the general iron mixtures. All cylinder heads, for example, are cast with metal melted in this cupola. This mixture is one of the company's specialities and has been proved over a period of years to be eminently successful for the purpose.

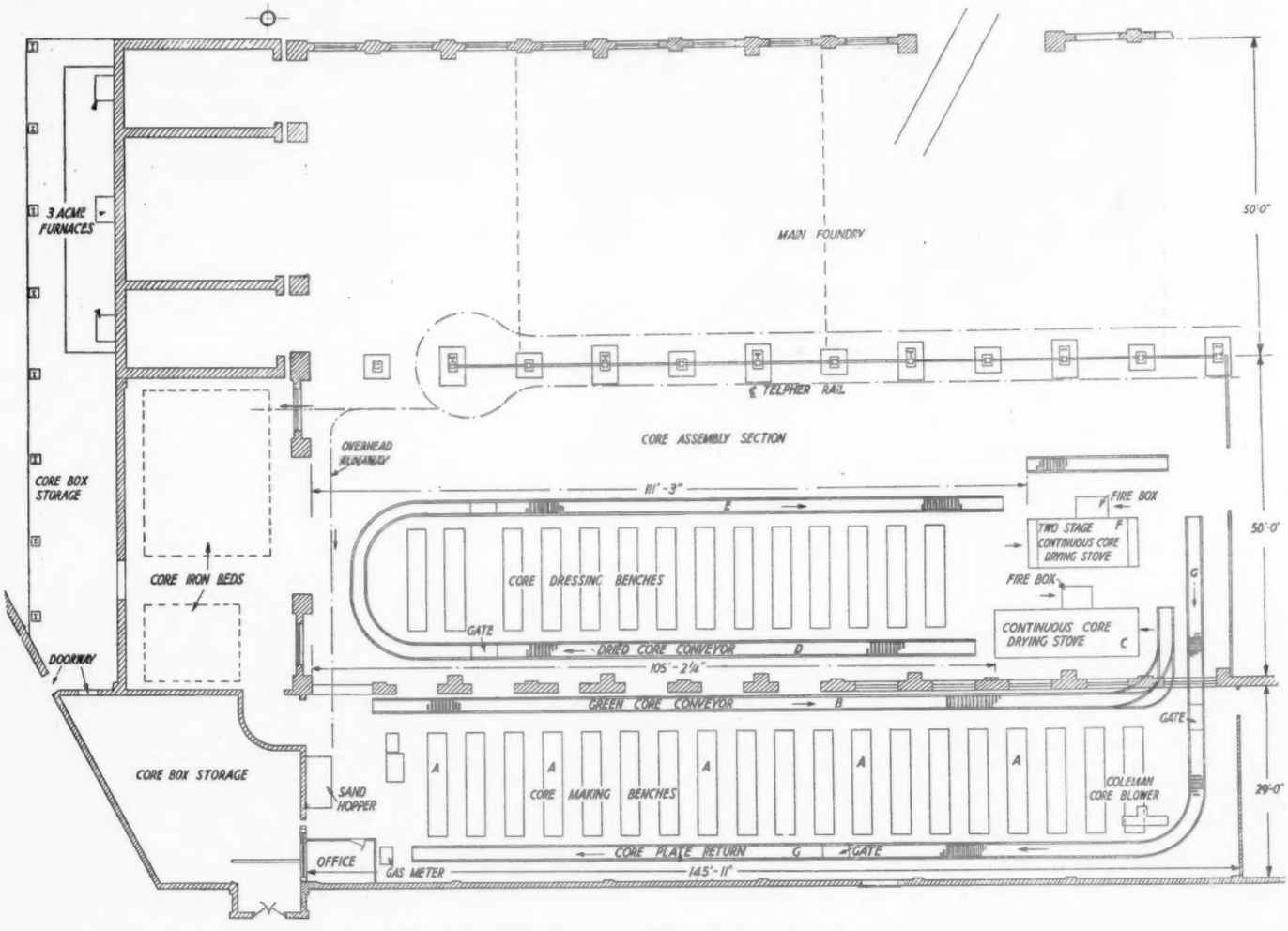


FIG. 2.—ARRANGEMENT OF CORE-MAKING DEPARTMENT.

THE MECHANISED FOUNDRY

This section of the foundry has been developed mainly for the batch production of the company's small and medium-section green-sand castings. Fig. 10 illustrates the general layout. It will be seen that an overhead belt 18 in. wide delivers prepared sand to ten hoppers, and Fig. 11 clearly shows the arrangement. The sand is ploughed off by means of V ploughs operated from the floor. Under eight of the hoppers are installed the latest-type moulding machines. These are as follows:—British Moulding Machine Company's turnover machines, Vogel and Schemmann turnover moulding machines, McNab Tabor jar ram squeeze machines, and Tabor squeeze machines, two of each make being installed.

The two remaining stations are utilised as hand-ramming stations for the oddments. After ramming, each half mould is placed on a short length of roller conveyor, cored and closed. Runner bushes, etc., are also put on here and the boxes clamped.

Moulding boxes are all of the Sterling steel type and are kept in good condition, thus ensuring accuracy and absence of twist. Further, being so much lighter than cast-iron boxes, fatigue is reduced although a greater number of boxes are handled each day than is the case with ordinary floor moulding. From the short lengths of roller conveyor the moulds are slid on to a plate conveyor supplied by Herbert Morris Limited. At this point the boxes are weighted and then proceed intermittently on the plate conveyor to the casting station, and Fig. 12 illustrates this operation. It will be seen that specially-designed ladles are employed, operated by one man with the aid of air-hoists and an overhead runway. Ladles having a capacity of up to 5 cwts. are easily handled in this way. After the casting operation the moulds proceed on the conveyor to the knock-out station where they are pulled off. The sand drops through a floor grid and returns to the sand preparing plant via a cleaning unit consisting of magnetic separator, screen, and dust and silt extractor. It should be noted at this point that all sand is elevated by means of inclined belts and not bucket elevators.

The moulding boxes are returned from the knock-out to the moulding machines by means of an assisted gravity roller conveyor. The castings are put on to a small slat conveyor and discharged into tubs, which in turn are picked up when full by a Morris overhead telpher and taken to the fettling shop.

The sand conveyor and preparing plant, shown in Fig. 13, which was installed by Augusts Limited, of Halifax, includes also an under-ground sand-spillage belt conveyor installed alongside the ramming stations which links up with the knock-out sand belt. Sand from both these conveyors discharges on to an inclined belt leading to the cleaning plant. The cleaned sand is discharged on to a second inclined belt and taken to the storage hopper over a No. 3 size August Simpson mill. The requisite quantity of cleaned sand is charged into the mill and any new additions added to the batch charge with batch mixing together with a continuous and uniform discharge on to the belt.

This plant has now been successfully working for two years, and regularly handles 20 tons of molten metal per day producing green-sand castings varying from one ounce to 2½ cwts. The molten metal is provided by a 3½-ton per hr. cupola which delivers into a ladle receiver from which the casting ladles are filled.

For castings requiring special metals, a separate roller conveyor system, horseshoe shaped, is used. The moulds are rammed on an adjacent machine and are cored, closed and cast on this roller conveyor. This arrangement allows for the special metal brought from the main foundry No. 3 cupola to be cast in batches instead of having such special jobs coming along irregularly on the main plate conveyor.

At the other end of this shop a Sandslinging plant has been installed. This plant can either be used for the larger-sized green-sand oddments or for batch production of medium-sized work. The Sandslinger is supplied from the main bulk sand ploughed off the overhead belt into a hopper. A spillage grid receives the spilled sand, which is returned by means of an elevator to the hopper again. The moulds are finished, cored and closed on roller conveyor lengths at right angles to the casting roller conveyor. This conveyor is on the same casting line as the main plate conveyor, and the same casting procedure is employed as described previously. Cast moulds are pushed up to the central knock-out station, and exactly the same procedure for disposal of castings, sand and empty boxes applies, as outlined in connection with the mechanised section.

FIG. 3.—GENERAL VIEW OF LIGHT CORE-MAKING SHOP. COLEMAN MACHINE IS IN THE LEFT FOREGROUND.

FIG. 4.—CORE ASSEMBLY FOR A SMALL VERTICAL ENGINE HOUSING.

FETTLING SHOP

This consists of two bays, 60 ft. wide and 150 ft. long, and is divided roughly into two sections: (*a*) light section dealing with all castings that can be handled without the use of a crane, and (*b*) heavy section, which is equipped with two 5-ton overhead cranes.

The castings are despatched from the foundry on a telpher crane (referred to when dealing with the mechanised foundry), and tipped in the fettling shop at the end of a belt conveyor, as shown in Fig. 14. The castings are then placed on the conveyor and fed into a rotary

FIG. 5.—GENERAL VIEW OF LIGHT CORE-DRESSING SHOP WITH ACME STOVES IN BACKGROUND.

FIG. 6.—GENERAL VIEW OF HEAVY FOUNDRY SECTION.

barrel shot-blast machine, designed by St. George's Engineers, Limited, which revolves at 3 r.p.m. and automatically discharges the castings at the rate of 2½ to 3 tons per hr. (Fig. 15), thus enabling the grinders and trimmers to receive a clean casting. After fettling, all castings are inspected before being batched up for despatch.

All castings that will not be in contact with oil are painted in the fettling shop before despatch. For this operation the dipping tank, shown in Fig. 16, is used, and the castings are then ready for storage at the various works. The delivery of castings to the heavy section is by rail, the overhead cranes having gantries outside the shop to serve the unloading and also the coring operations. The castings are decored over a grating made of expanded metal,

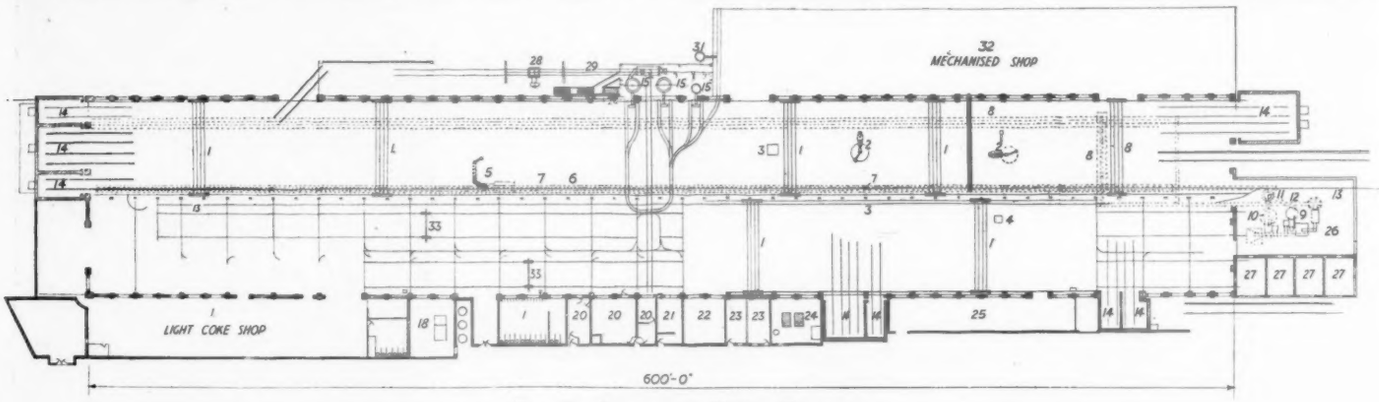


FIG. 7.—LAY-OUT OF HEAVY FOUNDRY.

1 = Overhead cranes. 2 = Portable sand slingers. 3 = 18 in. jar ram moulding machine. 4 = 12 in. jar ram moulding machine. 5 = Motive sand slinger. 6 = Overhead sand delivery belt to slinger. 7 = Plough points, 8 ft. intervals. 8 = Underground return belt to sand plant. 9 = No. 2 August sand mill and cleaning plant. 10 = No. 3 August sand mill and cleaning plant. 11 = Sand hopper with rotary feed table. 12 = Swinging belt conveyor. 13 = Telpher track. 14 = Mould drying stoves. 15 = Two 9-tons per hour balanced blast cupolas. 16 = One 4-ton per hour cupola. 17 = Light core shop. 18 = Compressor house. 19 = Lavatory. 20 = Offices. 21 = Foundry branch laboratory. 22 = Stores. 23 = Ambulance rooms. 24 = Boiler house. 25 = Millwrights' shop. 26 = Sand preparing room. 27 = Sand storage bins. 28 = Cupola charging and weighbridge. 29 = Overhead Telpher for cupola charging. 30 = Storage yard. 31 = 3½-tons per hour cupola for mechanised shop. 32 = Mechanised shop. 33 = 1-ton hand overhead runways.

FIG. 8.—VIEW OF CUPOLAS, SHOWING CONTINUOUS TAPPING AND TILTING SPOUT ARRANGEMENT.

FIG. 9.—TYPICAL GROUP OF CASTINGS MADE BY THE RUSTON & HORNSBY FOUNDRY.

FIG. 10.—MOULDING MACHINE STATIONS AND CLOSING OPERATION ON ROLLER PATHWAY.

FIG. 12.—MOULD PLATE CONVEYOR AND CASTING ARRANGEMENTS.

about 30 ft. long, beneath which there is a conveyor feeding the sand reclaiming room. They are then taken into the shop for shot-blasting. The shot-blasting machine, also by St. George's Engineers, Limited, consists of a chamber 25 ft. long and 10 ft. wide, placed at right angles to the cranes, having doors in either bays. A view is given of this in Fig. 17, which shows the method of working. Two bogies are used, one for each bay, and by this method one can be unloaded and re-loaded during the blasting operation, thereby using the plant to its utmost capacity.

For the fettling operations, the men are in gangs of two or three, and each gang is equipped with a modern pneumatic chipping hammer and high-speed portable grinder. Here, again, a very close inspection of all castings is made before allowing them to be despatched.

All fettling is on a piece-work basis, a rate per ton of castings produced in all cases being paid. It would, of course, be impossible to give an all-round rate, as the type and size of castings vary considerably, so a system was devised of splitting up the products into roughly twenty

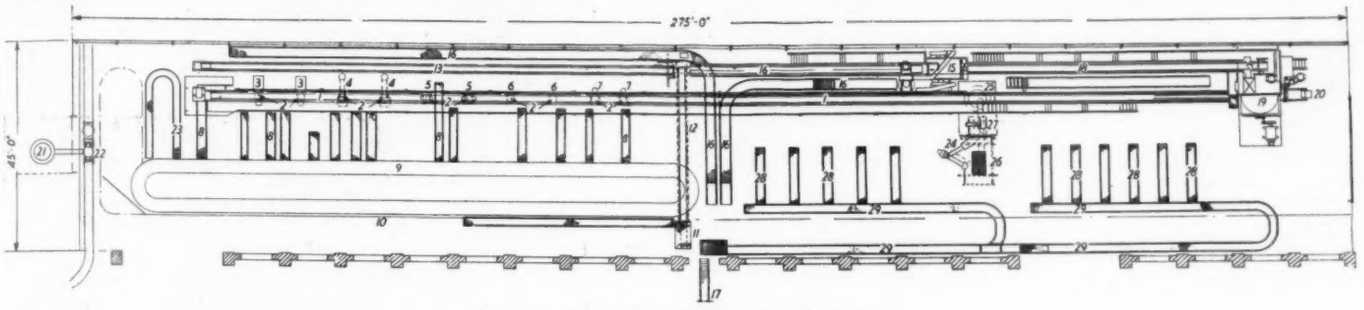


FIG. 11.—LAY-OUT OF MECHANISED FOUNDRY.

1 = Overhead sand delivery belt. 2 = Hoppers. 3 = Two British moulding turnover machines. 4 = Vogel & Schemmann turnover moulding machines. 5 = Two Tabor squeeze machines. 6 = Two hand-ramming stations. 7 = Two McNab Tabor jar ram squeeze machines. 8 = Closing roller conveyors. 9 = Plate conveyor. 10 = Overhead casting mono-rail. 11 = Knockout station. 12 = Return belt from knockout. 13 = Spillage belt conveyor. 14 = Inclined belt to cleaning unit. 15 = Sand-cleaning unit. 16 = Empty moulding box return. 17 = Slat conveyor for finished castings. 18 = Inclined belt for delivering sand to storage hopper. 19 = No. 3 August Simpson mill. 20 = Bucket loader. 21 = Cupola. 22 = Ladle receiver. 23 = Roller-conveyor system for special metal work. 24 = Sand slinger. 25 = Storage hopper. 26 = Spillage grid. 27 = Elevator. 28 = Closing roller conveyors. 29 = Casting roller convyors.

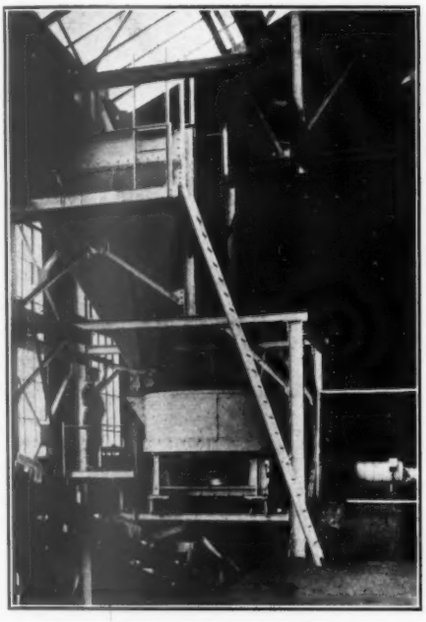


FIG. 13.—SAND STORAGE HOPPER AND AUGUST SIMPSON MILL IN MECHANISED SHOP.

FIG. 14.—CONTINUOUS ROTARY BLAST PLANT AND BELT CHARGING CONVEYOR.

FIG. 15.—CLOSE-UP OF DISCHARGE END OF ST. GEORGE'S ROTARY BLAST PLANT.

FIG. 16.—DIPPING PAINT TANK PLANT.

different sections and a price per ton being paid for each group. A view is given in Fig. 9 of some of the types of castings fettled in the heavy bay.

A large dust arrester, by St. George's Engineers, Limited, is installed in the shop to deal with the large room shot-blast, the continuous barrel blast and all the stationary grinding wheels. This plant is roughly 22 ft. long by 13 ft. wide, and is of the bag type, and will deal with 15,000 cub. ft. of air per min., the discharge being on the outside of the shop.

CORE-SAND RECOVERY DEPARTMENT

This process has been developed from Ruston & Hornsby laboratory research work extending over the past 18 months. Used silica core sand is now efficiently reclaimed on a large scale, and after mixing with core-oil compound, is made into satisfactory cores equal in every way in quality to those made from new sand. In fact, the "old" sand cores are superior, particularly in regard to increased green bond strength and permeability.

Briefly, the laboratory researches showed that dust and silt (*i.e.*, through 120 mesh) was the main factor influencing the properties and behaviour of re-used oil sand. At one time it was generally considered that roasting at a high temperature was essential if silica sand was to be recovered, but the experiments showed this to be unnecessary. In point of fact, heating of any description was found to be unnecessary, but passage of the sand through a rotary drier was found to assist in separating any silt which might be adhering to the sand grains.

Owing to the nature of the work produced in the Lincoln foundries, calling for collapsible cores, and also to oil sand suiting the female coremakers, the daily consumption of silica sand is of the order of 10 tons per day. The recovery of this quantity, therefore, represents a very considerable saving, particularly when dumping costs and facilities, together with the initial cost of new sand, are taken into account.

Reference to Fig. 18 shows the knock-out grid, previously referred to, under a crane gantry, where cores, etc., are knocked out from the castings. An underground belt conveyor passing over a magnetic separator takes the sand to an elevator which delivers into a rotary screen, where tailings are rejected and the screened sand delivered into an overhead storage hopper. From here the sand discharges continuously into a grinding mill, and then passes to the boot of a second elevator which takes it to another overhead storage hopper. From here it continuously discharges into a Pneulec rotary drier, and is subjected to heating and prolonged friction, which separates silt from the sand grains. The dried sand is then elevated and dropped on to a specially-designed shute made specially for this purpose by the Standard & Pochin Bros., of Leicester. This shute, shown in Fig. 19, forms a very cheap and efficient means of dust and silt separation. It consists of a channel-shaped shute having four weirs over which the sand cascades in the form of waterfalls. As the curtain of sand passes over each shute, it is subjected to a controlled air suction. The silt is collected by means of a cyclone and bag filter. The recovered sand from the bottom of the shute is loaded into an August bucket loader serving the two Rotoil oil-sand mixing machines, where the oil sand is prepared and then delivered to the core shops in quantity by means of the Aveling & Barford dumper, referred to earlier.

FIG. 17.—SHOT-BLAST ROOM, AND FRICTIONLESS BOGIE, SHOWING METHOD OF WORKING.

FIG. 19.—RIDDING SAND OF SILT BY CASCADING AND SUCTION.

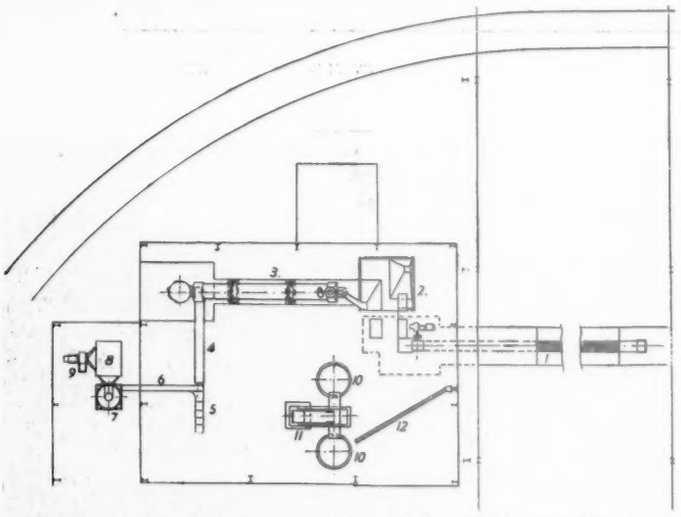


FIG. 18.—LAY-OUT OF CORE SAND RECLAMATION DEPARTMENT.

1.—Knock-out Grid with Underground Belt.
2.—Sand Screening and Milling Plant.
3.—Pneulec Rotary Sand Dryer.
4.—Elevator.
5.—Silt Exhausting Shute fitted with adjustable Weir Plates.
6.—Air Exhaust Piping.
7.—Cyclone.
8.—Bag Filter.
9.—Motor and Fan.
10.—Two Rotoil Oil Sand Mixing Machines.
11.—Bucket Loader.
12.—Jib Crane.

Patternshops

The patternshop is one of the finest in the country, having a floor area of 2,200 sq. ft. It is a single-storey building, as shown in Fig. 20, and comprises two bays, each 220 ft. long by 50 ft. wide. The roof is all glass and large windows are provided in all four walls, thus admitting the maximum daylight. Large doors at each end of the shop give easy access to drays taking large patterns to and from the foundry. Four overhead runways go the full length of the shop, each having 15-cwt. blocks. The benches also run in four lines, and these runways are convenient for handling large patterns during manufacture and when finished.

The shop is well provided with modern machinery, which includes:—"Universal" patternmaking machines; a number of various diameter double disc and bobbin sanders; dimension saw; circular saws, the largest taking a 30 in. dia. saw; power jig saw; drilling machines; morticing machine; band saws; planing machines for surface and thicknessing; planing machines, surfacing only; centre lathes; cross-cut saw; tool grinding machines; and a boring machine.

The "universal" patternmaking machines are worked by skilled patternmakers, and are working to full capacity all the time, very little face plate work being done in the lathes.

The machines (with the exception of the cross-cut saw and the lathes) are all driven from an underground shaft which runs the entire length of the shop. This is in three sections, each section being driven by separate motor, thus allowing any one section to be stopped at will. The machines are grouped either side of this drive so as to be easily accessible to the men working at the benches.

The wood refuse is taken direct to the boiler house by means of a suction fan connected to a

Clean Iron

Machine-cast iron is *clean*—all iron—free from sand fused on the surface. The absence of the usual siliceous skin exposes the whole surface at once to the melting process, gives quicker melting and requires less coke in the cupola. A fuel saving of quite 20% is common, besides an economy in limestone for fluxing, up to 50%

Machine-cast iron is uniform throughout the whole cast, easy to handle by hand or magnet; there are no unwieldy sows and the iron can be broken readily as it is notched for this purpose.

THE UNITED STEEL COMPANIES LTD

Write for the leaflet "Machine-Cast Iron" to the Publicity Dept., The United Steel Companies Ltd., 17, Westbourne Road, Sheffield, 10.

WORKINGTON

MACHINE-CAST IRONS

WORKINGTON IRON & STEEL COMPANY · WORKINGTON · CUMBERLAND

BRANCH OF THE UNITED STEEL COMPANIES LIMITED

W.31R

large central duct which has branch connections to each machine. The whole of the pattern-making for Lincoln, Grantham, and the associated firm, Ruston-Bucyrus, is done in the shop. The class of work naturally varies a great deal as regards size and design. With regard to size, this varies from small patterns to produce castings of only a few ounces weight to large patterns for bedplates and housings weighing up to 20 tons.

The coring of some of these moulds is so intricate that full sets of jigs for setting cores in the moulds are provided, also rubbing jigs to ensure cores are correct to shape and size. Many patterns are made for steel castings, these also being very complicated, embodying as many as over 100 cores in some of the large bedplates and truck frames. These castings also weigh many tons.

The paint shop is a special chamber fitted up with ventilating fan. Large patterns are spray painted. The colour scheme is:—*Pattern*, red; *core prints*, black, and *machined parts*, yellow; whilst patterns for special irons are painted blue.

As modern machining methods call for a much finer machining allowance than formerly and the design of castings is generally more intricate, inspection has to be very thorough. A section of the shop is fitted up with surface plates, scribing-blocks and vee-blocks, etc., and a staff of inspectors check each pattern with great care.

FIG. 20.—GENERAL VIEW OF THE PATTERNSHOP.

As the thorough seasoning of timber is very important, 12 to 18 months' supply is always kept in stock. This is skidded down in large drying sheds outside the shop. The average consumption of pine is about 100 standards per annum.

The normal working staff consists of 50 to 60 patternmakers and about eight apprentices, 90 per cent. being on piecework. It is believed Ruston & Hornsby were amongst the first people to introduce a straight piecework system in the patternshop. This was adopted in 1924, and has worked very satisfactorily ever since.

Ten to twelve patternmakers are kept continuously employed in the production of metal patterns and core boxes. Wherever the quantities-off warrant, metal (either cast iron, brass, aluminium or special zinc-alloy pattern metal) is employed. Such tackle is mainly used in the mechanised shop in order to ensure accurate castings, having minimum machining allowances and true to drawing dimensions. In addition, one man is kept solely employed in fixing and fitting metal inserts in the larger sized pattern and core boxes. Most of the pattern and core-box tackle for the large oil-engine work consists of composite wood and metal.

Acid Smelting in Blast Furnaces

At a Conference of the Vereins deutscher Eisenhüttenleute in Düsseldorf last autumn, Dr. Max Paschke discussed the acid smelting of siliceous iron ores with special reference to smelting the low-grade iron ores of this type in Germany. The lecturer first discussed the physical properties of low-grade acid ores and referred to a process developed by him and E. Peetz in 1934 for smelting acid iron ores with an acid slag and desulphurising the iron outside the blast furnace. This process has been further developed by H. A. Brassert at Stewarts and Lloyds works, at Corby and H. Röchling at Volklingen in Germany. It is based on the idea of maintaining the slag acid in the blast furnace, whilst reliance is placed on a special treatment of the molten pig-iron leaving the furnace for the removal of sulphur.

Under such conditions, the slag has a high degree of liquidity; silica, alumina, and limestone influence one another in different parts of the furnace and the degree of liquidity of the slag very considerably, and in this connection the alumina can be used as regulator. Other fluxing substances always present are: ferrous oxide, manganous oxide and alkalies, and these play an important part in influencing the melting point of the slag. The quantity of slag produced and the coke consumed are reduced, and the temperature of the bosh can be lower than otherwise. In contrast with the usual basic process, the sulphur in the pig-iron will be greater.

Inasmuch as the alumina content of acid iron ores is often quite small, it is suitable in certain cases to add to the furnace charge some aluminous material, such as low-grade bauxite.

In the new method, high-sulphur pig-iron, directly after tapping and while in the liquid condition, can be desulphurised by contact with a suitable basic material, which preferably may be sodium oxide added in the form of sodium carbonate. The pig-iron product is well suited for foundry purposes and for basic pig-iron, especially with low-grade acid iron ores containing phosphorus. The soda is added to the molten iron, either in the solid condition, or it can be previously melted in a drum furnace.

The lining of a soda melting furnace may be either magnesite or firebrick; the latter should contain only a moderate amount of alumina and be of limited porosity. Mixtures of limestone, fluorspar, and soda, in solid form, are also used for desulphurising. The desulphurising treatment can be repeated several times, with removal of the slag between each treatment, if a specially low-sulphur content pig-iron is required.

Manganese Conservation

Naturally, care must be taken to ensure intimate contact between the molten iron and the desulphurising medium. Dr. Paschke describes the use of an iron bath through which the iron, with a covering of slag, is made to flow continuously, and with devices for agitation. In this bath the light and very liquid slag rises to the surface and flows out of an opening in the upper part, while the desulphurised iron passes out of another opening in the lower part of the bath. It is claimed that the quality of the foundry and basic pig-iron produced by the new process of desulphurising is improved thereby; the employment of soda not only acts to remove sulphur, but the very liquid slag it produces has a good purifying influence on the iron, and carries away with it the greater part of the oxides and other non-metallic inclusions. Another advantage of the process is said to be a saving in manganese, because the considerable slagging of the manganese in the ore makes a manganese carrier unnecessary. Lately, iron ore low in manganese content has been treated by this method with satisfactory results. This method of operating, however, is more or less dependent upon the ratio of the silicon to the manganese in the pig-iron.

Types of Iron Produced

The following kinds of pig-iron can be produced by the process: (1) High-silicon and low-manganese basic pig-iron with some phosphate added to the furnace charge; (2) basic pig-iron of the usual kind and composition through smelting a high-sulphur iron ore in a blast furnace with an addition to the charge of a basic slag; (3) "silbereisen"* with less than 0.25 per cent. phosphorus; (4) foundry iron and hematite iron from ores low in phosphorus with after-treatment with soda, with desired silicon and carbon content.

Endeavours in Germany to develop metallurgically methods for economising the use of manganese in manufacturing steel, spiegeleisen, and ferro-manganese, include the blowing of soda into the bosh of the blast furnace; the effect of this is to reduce the amount of manganese passing into the slag, and correspondingly to enrich the iron in manganese. The decomposition of the soda in the furnace yields carbon dioxide, the reduction of which to carbon monoxide increases the coke consumption which, however, can be balanced by increasing the blast temperature, or by employing a blast enriched in oxygen.

The new process of smelting iron ores with acid slags, irrespective of their sulphur content, and removing the sulphur outside the furnace, can be used for ores with high sulphur otherwise not favourable for smelting to pig-iron, and coke relatively high in sulphur can also be used in the blast furnace. In Germany, for example, the process permits the use of high-sulphur lignite coke of sufficient strength and combustibility, thus introducing new possibilities.

The smelting of residual products or scrap with ordinary bauxite and limestone, with considerable excess of alumina over the silica content of the charge, yields a pig-iron high in carbon, low in silicon, and with properties differing from the usual pig-iron. The composition of the slag is principally calcium-aluminate instead of calcium silicate. The iron so produced is esteemed as a constituent of foundry iron and for the production of special steels, because of a low phosphorus content, while the slag, when finely ground, is a high-grade cement.

Titanium Pig-Iron

When the blast furnace is operated at high temperature with bauxite in the charge, pig-iron

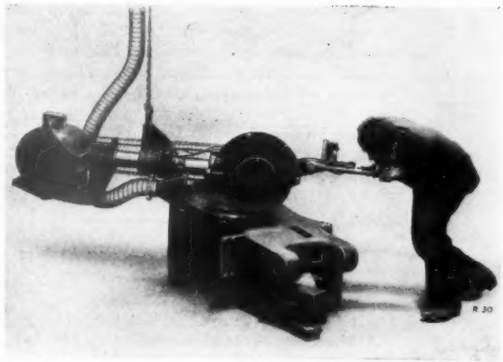
(*Concluded on page* 470.)

* Liquid iron mixed with liquid steel.

ROWLAND

30" MOTOR-DRIVEN HIGH SPEED GRINDER

GRINDING MACHINES for Fettling Shop Practice



HEAVY DUTY HIGH SPEED PORTABLE GRINDER

YOU can definitely save money in your Fettling Shop by installing "Rowland" High Speed Grinders. There are four sizes of Floor Machines for work that can be conveniently handled, and Portable Machines for work which is too heavy to carry to an ordinary Grinder.

All these Machines are built to take full advantage of the high metal removing capabilities of the Bakelite Bonded High Speed Grinding Wheel, which is run at a surface speed of 9,500 feet per minute, nearly twice the speed of the ordinary Grinding Wheel. Built to withstand continuous heavy duty these sturdy Grinders are the last word in up-to-the-minute Fettling Shop practice.

● *Write for details, for you cannot afford to run antiquated Slow Speed Grinders.*

F. E. ROWLAND & Co., Ltd., CLIMAX WORKS, REDDISH, STOCKPORT.

LONDON: Clyde Amos & Co., Ltd., 22, Martin Lane, Cannon Street, LONDON, E.C.4. MIDLANDS: L. Williams, Esq., 31, Parkside, COVENTRY.
N.E. COAST: T. Feather Esq., 16, Devonshire Place, Jesmond, NEWCASTLE-on-TYNE. SCOTLAND: Wilson Feather & Son, 122, Wellington Street, GLASGOW.
SHEFFIELD: Gregory & Taylor Ltd., Howard St., SHEFFIELD. LANCASHIRE, YORKSHIRE & CHESHIRE: Alex. W. Maycock, Esq., 15, Lindsay Ave., MANCHESTER, 19.

The Week's News in Brief

Trade Talk

The Rolls-Royce Company of Derby are to open up a new aero-engine factory at Crewe.

Lt.-Col. H. W. S. Outram has been elected President of the Institution of Engineering Inspection for the coming year.

Mr. Henry Reed, chairman of the Sheffield firm of Sanderson Bros. & Newbould, Limited, died suddenly on May 27, aged 68.

About 50 members of the Derby Society of Engineers visited the works of the International Combustion, Limited, Sinfin Lane, Derby.

The New Zealand Shipping Company, Limited, London, have placed an order with Alex. Stephen & Sons, Limited, Linthouse, Glasgow, for a cargo motorship of about 6,000 tons gross.

Alley & MacLellan, Limited, have received an order for the supply of two motor-driven vertical reciprocating air compressors for the Bengal and North-Western Railway at Gorakhpur, India.

An outbreak of fire at the premises of the Stanton Ironworks Company, Gunby Lane, Sewstern, Grantham, has caused damage estimated at over £600. The fire seems to have started in an electrical supplies store, spreading to the adjoining buildings.

Damage estimated at over a £1,000 was caused by a fire at the works of British Foundry Units, Limited, Chesterfield. A packing shed and its contents were completely destroyed. Arrangements have been made to carry on business as usual.

The Cargo Fleet Iron & Steel Company, Limited, Middlesbrough, are to close down one of their basic iron furnaces for relining and reconditioning. It is understood one of the furnaces at Seaton Carew, belonging to the South Durham Steel & Iron Company, may be blown out.

Sir Harry Greer, chairman of the Scottish Machine Tool Corporation, Limited, stated at the annual meeting on June 1 that the company's order-book was in an extremely healthy condition. He made the notable statement, however, that the armament programme is playing a comparatively small part in present operations. The total value of armament orders represents only 20 per cent. of the total work in hand.

Workers in the Singer factory at Clydebank were officially informed last week that the firm had decided to grant one week's holiday with pay to all workers with at least one year's service at the Fair Holiday next month. Workers with less than a year's service will receive the equivalent of one-fourth of a week's wage for each completed period of three months. Almost 9,000 employees will benefit by this holiday concession.

Jarrow Town Council has printed letters which are being sent to every M.P. and member of the Cabinet asking for support for the town's steelworks scheme. The letter outlines the history of the scheme, and stress is laid on the fact that it is a year since it was announced in the House of Commons that steelworks were to be provided at Jarrow. The letter alleges that delay has persisted throughout. The Special Areas Commissioner did not even take over the proposed site of the works until nine months after the House of Commons announcement and a lease was not completed until 10 months after. There had been no constructional work carried out. The letter further states that inquiries only revealed bewildering excuses. Nobody would accept blame for the delay, but yet there was no substantial progress with the work.

Obituary

Mr. James Howden Hume, who had been chairman for the past quarter of a century of the Glasgow engineering firm of James Howden & Company, Limited, died recently. Mr. Hume had been President of the Institution of Engineers and Shipbuilders in Scotland.

Dr. T. Baker, head of the research department and chief metallurgist at the Steel, Peech & Tozer works of the United Steel Companies, Limited, died at Rotherham on Saturday, aged 61. Dr. Baker began his education at the elementary and grammar schools at Wolsingham, Durham, and took his degrees at Armstrong College, Durham University, and Sheffield University. Research work at Sheffield University was followed by an appointment as manager and metallurgist with New Vanadium & Alloys, Limited, Llanelly, and from there Dr. Baker went to the Steel, Peech & Tozer works. He was stricken with illness nearly five years ago, but he was retained by the firm in an advisory capacity.

Mr. Percival Herbert Symonds, who died at his home at Hatch End, Middlesex, on Monday, May 23, in his 60th year, had a wide circle of friends in the engineering profession. At the time of his death he was special sales representative of the English Electric Company, Limited, his office being at the company's Stafford works. After a period with Swan, Hunter and Wigham Richardson, Limited, and other firms, Mr. Symonds joined the British Westinghouse Company, Limited, in 1905, and was engaged in their turbine department until 1907, when he left to join Willans & Robinson, Limited, at Rugby, where he remained until 1910. He then joined the Brush Electrical Engineering Company as turbine sales manager, and was the pioneer of sales of the Ljungström turbine in this country. In 1913 he re-joined Willans & Robinson, and remained there through the war. From 1920 to date he was with the English Electric Company, Limited.

Personal

Sir A. J. Bennett, Bt., a director of Ransome & Marles, engineers, Newark, has been married to Miss Leopoldina Armata.

Mr. F. A. Neil, Master Cutler of Sheffield, was among the distinguished visitors to the Empire Exhibition on June 2. His visit was purely unofficial. He took the opportunity of seeing the Exhibition with several friends while passing through Glasgow on a holiday tour.

Mr. John Bain, foreman of the Carron Company's metal warehouse, Falkirk, has retired after 62 years with the firm. He was presented with a Westminster chiming clock by his colleagues. Starting work at the age of 12, he has been in Carron all his working days, and during that period has served under six general managers and eight foundry managers.

The staff of John G. Stein & Company, Limited, gathered in the Castlecary works offices last week to honour Mr. James Forest, retiring manager of the firm's Bonnybridge Works, and secretary of the firm. Col. Alan Stein, M.C., D.L., chairman of the firm, presided, and paid tribute to Mr. Forest's 33 years' service. He handed Mr. Forest a cheque from the directors. The staff presented him with two easy chairs and a fishing rod.

Will

M'Neil, Charles, B.Sc., late of John M'Neil & Company, Limited, sugar machinery makers, Colonial Iron Works, Helen Street, Govan, Glasgow £22,214

Acid Smelting in Blast Furnaces

(*Concluded from page 468.*)

containing titanium is obtained. Titanium is a good deoxidising and de-nitrogenising agent, and with a view to economy in the use of manganese for deoxidation, it is possible that greater attention will be given to the iron and other ores which contain titanium available in Germany.

High-grade bauxite, low in silica, is in great demand for aluminium production, but the lower grades can be of great importance. By right control of the blast furnace charge and by blowing soda into the blast furnace, a slag would be obtained which, in the first place, would contain sodim aluminate soluble in water and valuable for alumina production, and an insoluble residue of great value as raw material in the cement-making industry.

Company Reports

Crompton Parkinson, Limited.—Interim ordinary dividend of 6 per cent. actual.

Electric Furnace Company, Limited.—Final dividend of 5½ per cent., making 8 per cent.

Consett Iron Company, Limited.—Dividend on the ordinary stock for the year ended March 31 of 10 per cent.

Allied Ironfounders, Limited.—Final dividend on the ordinary shares of 6 per cent., making 10 per cent. for the year.

Hick, Hargreaves & Company, Limited.—Final dividend of 3 per cent. and a bonus of 3 per cent., making 8 per cent. for the year.

Anderston Foundry Company, Limited.—Profit for year ended March 31 last, £8,084; to reserve, £2,000; dividend of 6¾ per cent.

Bradley & Foster, Limited.—Final dividend of 4 per cent., plus a bonus of 2 per cent., on the ordinary shares for the year ended March 31 last.

F. H. Lloyd & Company, Limited.—Final dividend of 5 per cent. on the ordinary shares, making 8 per cent. for the nine months ended March 31 last.

Stewarts and Lloyds of South Africa, Limited.—Dividend at the rate of 6 per cent. per annum on the first cumulative preference shares for the half-year to June 30.

Harland & Wolff, Limited.—Profit for the year 1937, before depreciation, £24,557; dividends and interest on investments, £2,170; brought in, £3,508; to trustees of staff pension fund, £12,923; carried forward, £17,312.

Aluminium Gaining Ground

The increasing production of aluminium in comparison with other metals is clearly revealed in an analysis of metal production during 1937, issued by the Aluminium Information Bureau. Comparing the tonnages for 1937 with corresponding figures for 1924, the analysis indicates that the production of aluminium and of nickel has increased three-fold, while the production of gold has doubled. Much smaller increases are shown by other metals, copper having increased by 74 per cent., zinc by 66½ per cent., tin by 47 per cent., iron by 42¼ per cent., lead by 33 per cent., and silver by only 6 per cent.

Before the war, aluminium came sixth in order of production of metals by weight, but is now fifth in the list. The extreme lightness of aluminium places it fourth among metals when measured by volume, for 100 tons of aluminium are equivalent in volume to 290 tons of iron. The use of aluminium has developed much more rapidly than the use of the older industrial metals. There were 825 tons of aluminium produced in 1913, 2,486 tons in 1924, and 5,236 tons in 1937 for every million tons of iron produced in each of those years. The following preliminary figures are given for 1937 showing world production in tons:—Iron, 95,500,000; copper, 2,300,000; zinc, 1,650,000; aluminium, 500,000; lead, 1,700,000; tin, 207,000; nickel, 100,000; silver, 7,750; and gold, 1,100.

R.A.F. Expansion

Sir Kingsley Wood, Air Minister, has appointed a panel of seven industrial advisers to the Air Ministry, representative of business, shipping, various branches of engineering, aircraft construction, petroleum and labour, to supervise the R.A.F. expansion programme. The panel will be directly responsible to the Air Minister and will submit its ideas, recommendations and criticisms to him. The members are:—Sir Amos Ayre, Mr. S. R. Beale, Mr. J. W. Bowen, Sir Charles Bruce-Gardner, Lord Cadman, Lt.-Col. J. H. M. Greenly, and Sir Malcolm McAlpine.

Forthcoming Events

JUNE 21-24.

International Engineering Congress:—To be held at the Empire Exhibition, Bellahouston Park, Glasgow.

Institute of British Foundrymen

JUNE 14-17.

Thirty-fifth Annual Conference at Bradford.

MOULDING SANDS *for* THE FOUNDRY

The selection of a moulding medium for the foundry necessitates the utmost care and attention. Higher casting temperatures have resulted in a demand for moulding sands of greater refractoriness and permeability, to withstand these severe conditions. General Refractories Limited, specialises in sand of this description. There is a great variety of sands and it is important to choose the one to suit your exact requirements. Some are mentioned below, but if you desire more detailed information, the Technical Department is always willing to make recommendations on hearing the conditions of individual problems.

YORKSHIRE MOULDING SAND
for Steel Castings

BRAMCOTE MOULDING SAND
for Iron and Brass Castings

THANET MOULDING SAND
for all kinds of Iron Castings

YORK YELLOW MOULDING SAND
for medium weight Iron Castings

ZENITH MOULDING SAND
for Iron and Brass Castings

MANSFIELD MOULDING SAND
for light Castings

CAVE BROWN MOULDING SAND
for medium size castings in Brass or Iron

Please address enquiries to the nearest Sales Office :

GENERAL REFRACTORIES LTD.

Telephone : *Sheffield* 31113 (6 *lines*). **GENEFAX HOUSE, SHEFFIELD, 10** *Telegrams :* *"Genefax, Sheffield."*

LONDON OFFICE : Russell House, Adam St. Strand, W.C.2. Telephone : Temple Bar 3511. Telegrams : "Genefax, Rand-London." (Mr. A. C. Turner).

SCOTTISH OFFICE : 48, West Regent Street, Glasgow, C.2. Telephone : Douglas 6108. Telegrams : (3 lines). "Genefax, Glasgow."

SWANSEA OFFICE : Metropole Chambers, Wind Street. Telephone : 3680. Telegrams : "Genefax, Swansea." (Mr. D. F. Hood-Williams).

MANCHESTER OFFICE : 9, Albert Square. Telephone : Blackfriars 6130. Telegrams : "Genefax, Manchester." (Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE : Halifax Bldgs., Exchange Place, Telephone : Middlesbrough 3313. Telegrams : "Genefax, Middlesbrough." (Mr. J. A. Williams).

BIRMINGHAM OFFICE : 5, Lower Temple Street, Telephone : Midland 6376. Telegrams : "Genefax, Birmingham." (Mr. G. Griffiths).

Raw Material Markets

The week preceding the Whitsuntide holiday was quiet, and little business was transacted in iron and steel. Holiday influences have not yet been shaken off. Now that prices of foundry pig-iron have been stabilised until the end of the year, consumers will be able to book ahead as they desire, but so far there has been little indication that there will be any immediate efforts to make new contracts. Supplies are available from producers' stocks, and further reductions in output have been made.

Pig-Iron

MIDDLESBROUGH.—Long-term buying is still not being entered into, and only a few small tonnages are changing hands at the present time. The news that more blast furnaces are being blown out is not regretted in the circumstances; it is realised that while stocks are so heavy consumers will not have sufficient orders to place to keep supplies from accumulating still further, and that it is in the interests of all concerned that the supply position is not allowed to get out of hand. For delivery in Middlesbrough or Falkirk up to the end of the year, No. 3 Cleveland G.M.B. foundry iron is quoted at 109s., with No. 1 foundry at 111s. 6d., and No. 4 foundry and No. 4 forge at 108s. Deliveries of hematite under contracts are falling behind schedule, not, as was the case last year, as the result of inadequate production, but owing to consumers being in possession of supplies which are much too large for their current consumption. East Coast mixed numbers are quoted at 132s. 6d. on the North-East Coast, 138s. in Sheffield, 140s. 6d. in Manchester, and 143s. 6d. in the Midlands.

LANCASHIRE.—Some consumers of pig-iron have placed orders for deliveries later in the year now that this is possible at fixed prices. Even so, only comparatively small tonnages have been contracted for. Makers of light castings are rather better placed, and it is hoped that this improvement will be continued. Some textile machinists, also, are receiving orders on a better scale; if these two branches make further headway, the outlook in this area will be much brighter. The invasion of China by Japan has had the effect of considerably curtailing the imports of British textile machinery to the former country. Trade in hematite continues to be on the quiet side.

MIDLANDS.—Local ironfounders continue to work short time—about three days in most instances—and consequently their stocks of pig-iron are not being very rapidly reduced. General quietness among light-castings makers is still prevalent, and it cannot be said that there is any indication of an early change in this section. For delivery to Birmingham and Black Country stations, Northamptonshire No. 3 foundry iron is quoted at 108s. 6d. per ton, with Derbyshire No. 3 at 111s. An additional 11d. per ton is invoiced if delivery into works is stipulated. Forge iron is quoted at 1s. below the prices of foundry irons. Consumers of low-phosphorus iron are fairly well employed, but still more business would be welcomed. The price of this iron varies from £5 15s. to £7 per ton, the latter figure being the quotation for Scottish iron. Moderate tonnages of hematite are being taken up under contracts, but the position is scarcely satisfactory. Producers are having to place a fair portion of their make into stock.

SCOTLAND.—There is still little change in the position of the light-castings manufacturers, who remain slack. New orders of any size are difficult to secure from any section. No. 1 foundry iron is quoted at 120s. 6d., with No. 3 at 118s., f.o.t. furnaces. Although consumption at the local steelworks continues to be heavy, they are not taking up further supplies, as they are already overstocked. Hematite mixed numbers are quoted at 133s., Scottish basic 107s. 6d., and English and Indian basic 100s., all less 5s. per ton rebate and delivered steelworks here.

Coke

There has not been much in the way of forward buying since Durham makers of foundry coke announced that their quotations would be lowered by 5s. per ton. Consumers had been pressing for reduced prices, but they are of the opinion that a more drastic cut might well have been made. Durham best foundry coke is now quoted at 34s. 6d. f.o.t. ovens, with varying delivered rates according to destination. For delivery in Birmingham and district, best Durham foundry coke is quoted at 50s. 6d., with Welsh coke at the same figure. Durham blast-furnace coke is now 30s. at ovens, or 33s. 6d. to 34s. delivered Middlesbrough furnaces.

Steel

The demand for heavy finished steel appears to have become very quiet. Orders have fallen away very surprisingly. A short time ago makers were having difficulty in complying with their contract commitments, but now consumers are not calling for their full tonnages. Activity in light steel products, also, has declined. The demand for bright-drawn steel is good.

Scrap

It has been decided that the fixed price schedules for steel scrap shall remain in operation until the end of September. In most districts the demand for scrap remains very weak, although some improvement has been reported in the call for cast iron in Lancashire. This material is in increased demand owing to the difference between scrap prices and foundry pig-iron quotations. Scottish steelworks continue to receive heavy deliveries of scrap, but works in other areas are already overstocked.

Metals

The Whitsuntide holiday has interfered with business on the Metal Exchange this week and conditions generally have been quiet.

Copper.—Although the demand for copper remains small, the market has strengthened during the past week, largely as the result of the announcement that drastic steps are being taken by United States producers to remedy the unsatisfactory statistical position of the metal. This news was responsible for an increase in the quotation on the London market. The Kennecott Copper Corporation has decided to stop production by its domestic subsidiaries for at least one month commencing June 15. In making this announcement the company stated that due to the large stocks accumulated during the past eight months, as the result of constantly shrinking business and with production still greatly in excess of the tonnage which it is possible to sell, it has become imperative, notwithstanding the drastic effect, to reduce production to a degree more nearly in keeping with current market requirements. A short time ago, it will be recalled, the Anaconda concern closed down several of its mines. A statement issued by the Agence Economique reveals that the Union Minière du Haut-Katanga intends to maintain its copper production at the same level as previously, although some reduction in native labour is contemplated. This concern intends to develop prospecting in the south-east region of its concessions, where interesting copper deposits have been located. As the result of Field-Marshal Goering's appeal that German raw materials should be exploited to their fullest extent, the Gewerkschaft Danielszug zu Kupferberg is to recommence activity at its copper mine in Rhineland, a concession that has not been worked since 1918.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £33 18s. 9d. to £34; Friday, £34 8s. 9d. to £34 11s. 3d.; Tuesday, £34 17s. 6d. to £35; Wednesday, £34 8s. 9d. to £34 10s.

Three Months.—Thursday, £34 2s. 6d. to £34 5s.; Friday, £34 12s. 6d. to £34 15s.; Tuesday, £35 3s. 9d. to £35 5s.; Wednesday, £34 13s. 9d. to £34 15s.

Tin.—The export quota for tin was reduced from 55 per cent. to 45 per cent. of operative tonnages by the International Tin Committee at its meeting in Paris on Thursday last. The standard tonnages of Malaya and the Netherlands East Indies are increased by 7½ per cent. The revised export quota includes provision for a buffer stock, but the percentage for this purpose will be announced at a later date. The Committee states that they have agreed in principle to the creation of a buffer stock to be constituted on the lines of the skeleton scheme already submitted to the signatory Governments. They appointed a sub-committee which will elaborate the draft into a complete scheme as rapidly as possible. It is anticipated that the complete scheme will be placed before a meeting of the Tin Committee to be held in London prior to July 1.

The market was surprised by the publication of the tin statistics for the month of May. The returns of Mr. W. H. Gartsen (Henry Rogers, Sons & Company) indicate that the total visible supply declined in May to 18,059 tons, from 19,041 tons in April. Including the carry-overs in the Straits Settlements and at the Arnhem (Holland) smelter, the visible supply amounted to 26,308 tons in May, as compared with 28,902 tons in the previous month.

Official quotations were as follow :—

Cash.—Thursday, £167 15s. to £168; Friday, £170 5s. to £170 10s.; Tuesday, £173 to £173 5s.; Wednesday, £171 5s. to £171 10s.

Three Months.—Thursday, £168 5s. to £168 10s.; Friday, £170 15s. to £171; Tuesday, £173 10s. to £173 15s.; Wednesday, £171 15s. to £172.

Spelter.—No expansion in demand is noticeable, and the outlook for this metal remains disappointing. Production continues to be maintained, and consequently stocks are accumulating rather too rapidly for the welfare of the market.

Daily market prices :—

Ordinary.—Thursday, £12 6s. 3d.; Friday, £12 6s. 3d.; Tuesday, £12 8s. 9d.; Wednesday, £12 7s. 6d.

Lead.—Business in this market, also, is slack, and stocks are rising, as the current output is in excess of the demand.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £13 10s.; Friday, £13 11s. 3d.; Tuesday, £13 11s. 3d.; Wednesday, £13 6s. 3d.

Scrap.—Despite the holiday influence, some small broadening of demand appears to have set in in this section. A few buyers have been induced to take up supplies as the result of the low prices obtaining. A return to large-scale business, however, is not anticipated in the prevailing circumstances.

Approximate selling prices for old metal :—New aluminium cuttings, £75; rolled, £58; cast, £30; foil, £88. Copper, £31 to £34; braziery, £27. Brass (clean), £20 to £23. Zinc, £7. Lead, £11. Gunmetal, £34.

International Ferro-Silicon Syndicate

The International Ferro-Silicon Syndicate, which has its headquarters at Vienna, has been prolonged for short periods of several months recently, various difficulties having prevented a long-term extension. It has, however, now been found possible to make an extension of a year in spite of the undercutting of prices which continues to be practised by Scandinavian producers. The German ferro-silicon sales organisation has also been extended for a year, but that country now produces such a heavy tonnage of this ferro-alloy that only small quantities have to be imported. At the moment, imports are limited to about 1,800 tons per month of high-grade 90 per cent. ferro-silicon, of which about 70 per cent. comes from Norway and the remainder from Sweden, Jugoslavia, Canada and Switzerland.

IN STOCK
TILGHMAN RECONDITIONED
SHOT OR SAND BLAST PLANTS
Rooms, Barrels, & Chambers.
WE SHOT AND SAND
BLAST FOR ALL TRADES
Established Fifty Years.
R. J. RICHARDSON & SONS, LTD.,
Commercial Street, Birmingham, 1.
Phone: MIDLAND 2281
Grams: "SANDBLAST, B'HAM"

HONEST FACT – WITHOUT FRILLS

MANSFIELD STANDARD MOULDING SAND

is still — as always

THE "MASTER"

MOULDING SAND

SHIPPED TO ALL PARTS OF THE WORLD

PULVERISED AND AERATED READY FOR USE IF DESIRED

MANSFIELD STANDARD SAND CO., LTD.

Tel. 201–2 **MANSFIELD, ENGLAND.**

WARNER *Special* **PIG IRONS**

- *Warner C.B.R.*
  and
- *Low Carbon Cylinder*
  (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- *Low Carbon Malleable*
  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD
CARGO FLEET · MIDDLESBROUGH

RAW MATERIALS—PRICE LIST

(Wednesday, June 8, 1938)

COPPER

	£	s.	d.
Standard cash	34	8	9
Three months	34	13	9
Electrolytic	38	10	0
Tough	38	5	0
Best selected	38	15	0
Sheets	68	0	0
India	51	7	6
Wire bars	40	0	0
Ingot bars	40	0	0
H.C. Wire rods	43	10	0
Off. av. cash, May	36	14	$2\frac{5}{11}$
Do., 3 mths., May	36	19	$0\frac{9}{22}$
Do., Sttlmnt., May	36	14	$2\frac{5}{11}$
Do., Electro, May	41	5	$1\frac{4}{11}$
Do., B.S., May	40	15	10
Do., Wire bars, May	41	13	$2\frac{2}{11}$
Solid drawn tubes			$11\frac{1}{2}$d.
Brazed tubes			$11\frac{1}{2}$d.
Wire			$7\frac{1}{2}$d.

BRASS

Solid drawn tubes	$10\frac{1}{2}$d.
Brazed tubes	$12\frac{1}{2}$d.
Rods, drawn	$8\frac{1}{2}$d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	$7\frac{1}{2}$d.
Wire	$7\frac{1}{2}$d.
Rolled metal	$7\frac{1}{2}$d.
Yellow metal rods	6d.

TIN

	£	s.	d.
Standard cash	171	5	0
Three months	171	15	0
English	171	5	0
Bars	173	5	0
Straits	173	15	0
Eastern	172	15	0
Banca (nom.)			—
Off. av. cash, May	162	16	$8\frac{5}{11}$
Do., 3 mths., May	163	8	9
Do., Sttlmt., May	162	16	$9\frac{9}{11}$

SPELTER

	£	s.	d.
Ordinary	12	7	6
Remelted	10	5	0
Hard	9	15	0
Electro, 99.9	16	6	3
English	13	15	0
India	12	10	0
Zinc dust	17	15	0
Zinc ashes	5	5	0
Off. aver., May	12	15	$6\frac{5}{22}$
Aver., spot, May	12	13	$7\frac{7}{11}$

LEAD

	£	s.	d.
Soft foreign, ppt.	13	6	3
Empire (nom.)	14	8	9
English	15	10	0
Sheets, home	21	10	0
Do. export	17	7	6
Pipes, home	21	0	0
Do. export	18	0	0
Tea lead	29	12	6
Off. aver., May	14	5	$10\frac{35}{88}$
Aver., spot, May	14	4	$2\frac{5}{11}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.		£	s.	d.
Zinc sheets, English	27	5	0 to	27	15	0	
Do., V.M. ex-whse.	27	5	0 to	27	15	0	
Rods				19	0	0	

ANTIMONY

	£	s.	d.		£	s.	d.
English	72	0	0 to	78	0	0	
Chinese, ex-whse.				56	0	0	
Crude, c.i.f.				32	10	0	

QUICKSILVER

	£	s.	d.
Quicksilver	13	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.
Ferro-silicon—			
25%	12	10	0
45/50%	12	0	0
75%	17	0	0
Ferro-vanadium—			
35/50%	14/- lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	4/9 lb. Mo.		
Ferro-titanium—			
20/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£21 to £22		
Ferro-tungsten—			
80/85%	4/8 lb.		
Tungsten metal powder—			
98/99%	4/9½ lb.		
Ferro-chrome—			
2/4% car.	34	15	0
4/6% car.	24	5	0
6/8% car.	24	0	0
8/10% car.	24	0	0
Ferro-chrome—			
Max. 2% car.	36	0	0
Max. 1% car.	38	5	0
Max. 0.5% car.	41	0	0
70% carbon-free	10d. lb.		
Nickel—99.5/100%	£180 to £185		
"F" nickel shot	£165	0	0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese—			
76/80% loose	£18 15 0 to 19	5	0
76/80% packed	£19 15 0 to 20	5	0
76/80% export	£22	0	0
Metallic manganese—			
94/96% carbon-free	1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

SCRAP

South Wales (West)—	£	s.	d.	£	s.	d.
Heavy steel, best	3	8	9 to 3	11	3	
Mixed iron and steel	3	6	9 to 3	9	3	
Heavy cast iron	3	8	9 to 3	11	3	
Good machinery				3	10	0
Cleveland—						
Heavy steel, best	3	7	0 to 3	9	6	
Steel turnings	2	13	0 to 2	15	6	
Heavy cast iron				3	10	0
Heavy machinery				3	15	0
Midlands—						
Short heavy steel				3	12	6
Light cast-iron scrap				3	2	6
Heavy wrought iron	4	0	0 to 4	5	0	
Steel turnings	2	6	3 to 2	8	9	
Scotland—						
Heavy steel best	3	5	0 to 3	7	6	
Ordinary cast iron	3	13	6 to 3	15	0	
Cast-iron borings	2	0	6 to 2	3	0	
Wrot-iron piling	4	5	0 to 4	7	6	
Heavy machinery	3	17	6 to 4	0	0	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	27	0	0
Brass	17	0	0
Lead (less usual draft)	12	0	0
Tea lead	8	0	0
Zinc	6	10	0
New aluminium cuttings	67	0	0
Braziery copper	23	0	0
Gunmetal	28	0	0
Hollow pewter	115	0	0
Shaped black pewter	78	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
„ No. 3	109/-
„ No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
„ d/d Birm.	144/6
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
„ No. 3 fdry.	111/-
Northants forge	107/6
„ fdry. No. 3	108/6
„ fdry. No. 1	111/6
Derbyshire forge	110/-
„ fdry. No. 3	111/-
„ fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
„ No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
„ „ Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
„ fdry. No. 3	108/6
Lincs forge	107/6
„ fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	137/6
Clyde, No. 3	137/6
Monkland, No. 3	137/6
Eglinton, No. 3	137/6
Gartsherrie, No. 3	137/6
Shotts, No. 3	137/6

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to	13	15	0
Nut and bolt iron	11	12	6 to	12	2	6
Hoops				14	2	6
Marked bars (Staffs) f.o.t.				15	15	0
Gas strip				14	2	6
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ¼ in. (untested)				12	4	0
Flats—8 in. wide and over				11	5	6
„ under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	19	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. („)				18	10	0
Galv. flat shts. („)				19	0	0
Galv. fencing wire, 8g. plain				20	5	0
Billets, soft, 100-ton lots				7	17	6
Sheet bars				7	15	0
Tin bars				7	15	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	10d.
Sheet to 10 w.g.	$10\frac{1}{2}$d.
Wire	12d.
Rods	12d.
Tubes	$17\frac{1}{2}$d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	40/- to 42/6
„ furnace	32/6
Durham foundry	34/6
„ furnace	30/-
Scottish foundry	40/-
„ furnace	35/- to 37/6

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box	20/3 to 21/6
„	28×20 „	40/6 to 43/-
„	20×10 „	29/-
„	18¾×14 „	21/-
C.W.	20×14 „	19/- to 20/3
„	28×20 „	38/- to 40/6
„	20×10 „	27/-
„	18¾×14 „	19/9 to 20/-

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	£11	0	0 to	£12	0	0	
Bars-hammered, basis	£20	0	0 to	£22	0	0	
Bars and nail-rods, rolled, basis	£19	0	0 to	£20	0	0	
Blooms	£18	0	0 to	£19	0	0	
Keg steel	£30	0	0 to	£35	0	0	
Faggot steel	£19	0	0 to	£24	0	0	
Bars and rods dead soft st'l	£14	0	0 to	£16	0	0	

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.	
June	2	..	33	18	9	inc. 20/-
,,	3	..	34	8	9	,, 10/-
,,	7	..	34	17	6	,, 8/9
,,	8	..	34	8	9	dec. 8/9

Standard Tin (cash)

			£	s.	d.	
June	2	..	167	15	0	inc. 95/-
,,	3	..	170	5	0	,, 50/-
,,	7	..	173	0	0	,, 55/-
,,	8	..	171	5	0	dec. 35/-

Spelter (ordinary)

			£	s.	d.	
June	2	..	12	6	3	inc. 8/9
,,	3	..	12	6	3	No change 2/6
,,	7	..	12	8	9	,, 2/6
,,	8	..	12	7	6	dec. 1/3

Lead (soft foreign, prompt)

			£	s.	d.	
June	2	..	13	10	0	inc. 3/9
,,	3	..	13	11	3	,, 1/3
,,	7	..	13	11	3	No change
,,	8	..	13	6	3	dec. 5/-

Electrolytic Copper

			£	s.	d.	
June	2	..	37	15	0	inc. 10/-
,,	3	..	38	5	0	,, 10/-
,,	7	..	39	0	0	,, 15/-
,,	8	..	38	10	0	dec. 10/-

Tin (English ingots)

			£	s.	d.	
June	2	..	167	15	0	inc. 95/-
,,	3	..	170	5	0	,, 50/-
,,	7	..	173	0	0	,, 55/-
,,	8	..	171	5	0	dec. 35/-

Spelter (Electro, 99.9 per cent.)

			£	s.	d.	
June	2	..	16	3	9	inc. 10/-
,,	3	..	16	5	0	,, 1/3
,,	7	..	16	7	6	,, 2/6
,,	8	..	16	6	3	dec. 1/3

Lead (English)

			£	s.	d.	
June	2	..	15	15	0	inc. 5/-
,,	3	..	15	15	0	No change
,,	7	..	15	15	0	,, ,,
,,	8	..	15	10	0	dec. 5/-

A COMPARISON OF CAST-IRON SCRAP PRICES

Average Monthly Prices of Cast-Iron Scrap in the Principal Districts in the Years 1932–38

SCOTLAND (Heavy Machinery)—

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
1932..	£ 2 s. 15 d. 0	£ 2 s. 15 d. 0	£ 2 s. 12 d. 6	£ 2 s. 10 d. 6	£ 2 s. 7 d. 6	£ 2 s. 5 d. 3	£ 2 s. 4 d. 5	£ 2 s. 3 d. 10	£ 2 s. 4 d. 10	£ 2 s. 4 d. 4	£ 2 s. 4 d. 0	£ 2 s. 4 d. 8	£ 2 s. 7 d. 8
1933..	2 7 0	2 9 3	2 10 8	2 10 5	2 9 5	2 9 3	2 8 6	2 10 9	2 10 4	2 10 7	2 10 10	2 12 4	2 9 11
1934..	2 14 2	2 17 9	2 18 5	2 18 3	2 15 5	2 15 9	2 14 3	2 15 0	2 15 9	2 15 0	2 15 8	2 16 3	2 16 0
1935..	2 15 5	2 15 8	2 15 10	2 16 4	2 16 10	2 17 0	2 16 9	2 16 9	2 17 0	2 16 11	2 19 11	3 2 7	2 17 5
1936..	3 4 8	3 9 10	3 10 11	3 11 10	3 10 8	3 9 10	3 9 2	3 8 9	3 8 11	3 9 2	3 10 0	3 13 3	3 9 9
1937..	3 15 0	4 2 10	4 6 2	4 9 9	4 14 9	4 15 0	4 15 0	4 15 0	4 15 0	4 15 6	4 15 0	4 13 3	4 11 0
1938..	4 11 3	4 11 3	4 8 3	4 5 7	4 1 2	—	—	—	—	—	—	—	—

N.E. COAST (Heavy Qualities)—

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
1932..	£ 2 s. 6 d. 3	£ 2 s. 5 d. 8	£ 2 s. 3 d. 0	£ 2 s. 0 d. 8	£ 1 s. 19 d. 0	£ 2 s. 1 d. 0	£ 1 s. 15 d. 9	£ 1 s. 15 d. 6	£ 1 s. 15 d. 6	£ 1 s. 15 d. 6	£ 1 s. 17 d. 4	£ 1 s. 19 d. 10	£ 1 s. 19 d. 7
1933..	2 1 1	2 2 2	2 4 9	2 3 5	1 18 9	1 19 6	2 0 0	2 0 0	2 1 3	2 5 8	2 7 10	2 10 1	2 5 4
1934..	2 12 7	2 15 1	2 13 7	2 11 6	2 11 11	2 13 9	2 11 0	2 10 6	2 11 3	2 11 10	2 13 9	2 13 3	2 12 4
1935..	2 12 2	2 13 0	2 12 7	2 13 0	2 12 9	2 12 6	2 12 6	2 12 6	2 12 6	2 12 6	2 12 6	2 16 10	2 12 10
1936..	3 0 0	3 1 10	3 1 8	3 2 2	3 4 6	3 3 9	3 5 9	3 4 1	3 5 11	3 6 3	3 6 3	3 7 10	3 4 2
1937..	3 10 6	3 14 9	4 2 6	4 3 9	4 6 3	4 7 6	4 7 6	4 7 6	4 6 0	4 5 0	4 5 0	4 5 0	4 3 5
1938..	4 5 0	4 2 6	4 0 0	3 18 1	3 11 3	—	—	—	—	—	—	—	—

S. WALES (Heavy Cast Iron)—

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
1932..	£ 2 s. 7 d. 2	£ 2 s. 6 d. 8	£ 2 s. 6 d. 4	£ 2 s. 5 d. 0	£ 2 s. 4 d. 8	£ 2 s. 0 d. 8	£ 1 s. 19 d. 4	£ 2 s. 1 d. 7	£ 2 s. 1 d. 10	£ 1 s. 18 d. 10	£ 1 s. 19 d. 8	£ 2 s. 2 d. 1	£ 2 s. 2 d. 0
1933..	2 3 4	2 4 6	2 4 6	2 4 1	2 3 5	2 2 8	2 3 7	2 4 2	2 5 8	2 5 9	2 5 7	2 5 0	2 4 5
1934..	2 6 10	2 8 9	2 7 8	2 6 6	2 7 6	2 8 0	2 6 10	2 6 7	2 8 0	2 8 2	2 9 1	2 11 5	2 7 1
1935..	2 11 3	2 11 4	2 11 1	2 11 3	2 12 0	2 11 1	2 11 1	2 11 0	2 12 2	2 13 10	2 14 5	2 14 8	2 11 9
1936..	2 16 3	2 18 7	2 18 9	2 19 2	2 18 7	2 19 0	2 19 0	2 18 9	2 18 9	2 19 0	2 19 2	2 19 0	2 18 8
1937..	3 4 1	3 9 8	3 9 3	3 9 0	3 9 0	3 9 0	3 9 0	3 9 0	3 8 9	3 9 9	3 9 9	3 9 11	3 8 10
1938..	3 10 0	3 10 0	3 10 0	3 10 0	3 10 0	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK
LIMPET

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND
FERRO-SILICON—FERRO-CHROME—NICKEL-CHROME

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS,
93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD,
MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

BRASSFOUNDERS
have you trouble with
SCRAP?

Here is the man to put you right. Reduction of scrap and higher efficiency certain. 17 years' experience in England and on the Continent in plumbers' work and engineering (foundry, hot-pressings, machining, organisation, management). Degree of Continental University. Best references.—Box 972, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER desires change. Modern methods; good organiser. Vast experience in general engineering and machine tools. Green or dry sand. Efficiency. First-class refs. Age 48.—Box 970, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER desires change. Modern methods, good organiser, vast experience. Machine tool, high-duty or repetition production; economy; efficiency. First-class refs. Age 40. I.B.F. man.—Box 956, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNMAKER wants job. Age 23. Experienced in oil and gas engines, agricultural. Any district. Further particulars willingly.—T. O. SPRINGFIELD, 23, Harrow Street, Grantham.

FOUNDRY FOREMAN, experienced in non-ferrous castings. Must be able to control core-making and labour, and must have thorough knowledge of oil-sand cores and plate moulding. State age, experience, and wages required.—Box 966, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

KENT EDUCATION COMMITTEE.

MEDWAY TECHNICAL COLLEGE.

APPLICATIONS are invited for the position of full-time Teacher of Metallurgy. Candidates must be graduates in Metallurgy, including non-ferrous metals. Industrial experience in this branch of work is also particularly desirable.

Duties will include the teaching of Metallurgy in day and evening classes to engineering students in National and Higher National Certificate Courses, and will further include the teaching of Analytical Chemistry to the standard of subsidiary final B.Sc.

Forms of application can be obtained from the District Education Officer, Fort Pitt House, New Road, Rochester, and should be forwarded, when completed, to the Head of Senior Departments, Medway Technical College, Gillingham, Kent, not later than June 30.

P. R. MORRIS.
Director of Education.

METALLURGIST wanted, possessing first-class qualifications and experience in modern furnace practice. Apply by letter only, stating age and salary required to: SHELL-MEX & B.P., LTD., Fuel Oil Department, Shell-Mex House, London, W.C.2.

SALES AND COSTS MANAGER wanted by ironfounders making small and medium high-class grey-iron castings, to control sales and costing organisation. Experience essential and preferential. Consideration given to applicant who can introduce business. State age, experience, and terms to: Box 948, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, W.C.2.

SITUATIONS VACANT AND WANTED—*Contd.*

REQUIRED for early July, 25/30 years' applicant for sales office handling travellers selling all raw materials to foundry and steel trade. Experience of sales office essential. Energetic, initiative and modern outlook. State salary and full experience.—Box 958, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

VITREOUS ENAMELLING.—Required for Midlands, young man to train as personal Assistant to Works Manager. Previous experience in charge of vitreous enamelling an asset, but good all-round knowledge of workshop practice and costing, with ability to control labour essential. No replies considered unless full particulars are given regarding age, previous experience, and salary required. All replies will be treated in strictest confidence.—Box 968, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY MANAGER desires change. Wide experience as manager in light-castings and engineering repetition work, also in control of general foundries. South technical training, excellent credentials. (324)

LIGHT CASTINGS TRADE.—Position required as Foreman or Assistant. Experience with first-class light-castings firms, also malleable experience. Technical training. (325)

PRACTICAL FOUNDRY FOREMAN desires position. Experience on repetition work, including plate and machine moulding; also on general castings, small, medium and large size. Technical training. (326)

AGENCY

ACTIVE AGENT with first-class connection, constantly covering London and 50 miles radius, seeks additional line, preferably Small Repetition Grey Iron or Brass Castings. Results absolutely guaranteed. Only well-established firms able to cope with substantial quantities entertained.—Box 856, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

FURNACE for melting half a ton lots at a time of special expensive grey-iron alloys wanted. State details and cost to: Box 946, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

THOS. W. WARD LTD.

Two LANCS. BOILERS; 28′ x 8′ 6″; 160 lbs. w.p.

COCHRAN BOILER; 12′ 3″ x 5′ 6″; built 1925; 100 lbs. w.p.

Large and varied stock of OIL AND PETROL STORAGE TANKS, lying in various parts of the country.

Approx. 20 tons of good second-hand ANGLE IRON, about 1½″ x 1½″ x $\frac{5}{16}$″ random lengths varying from about 10/20′ and slightly over.

Write for "Albion" Catalogue.

ALBION WORKS, SHEFFIELD.

'Grams: "Forward." 'Phone: 23001 (10 lines).

MACHINERY—*Continued*

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO., LTD., Station Works, Ecclesfield, Sheffield.

'Phone 98 Staines.

SCREWING MACHINE, up to 6-in. pipe, by Louden.

2½-ton Overhead Hand Crane, 22-ft. span.

Ingersoll Rand Compressor, Type 14.

Air Receiver, 6 ft. 6 in. by 2 ft. 6 in., 100 lbs.

HARRY H. GARDAM & CO., LTD.,
STAINES.

SANDBLAST PLANTS.

ROOMS size, 12 ft. by 12 ft., 12 ft. by 9 ft., and 6 ft. by 6 ft.

Barrels: 54 in. by 36 in.; 36 in. by 30 in.; 30 in. by 20 in., etc.

Cabinet: 6 ft. by 4 ft.; 4 ft. 6 in. sq. by 3 ft. 6 in. sq., and 30 in. dia.

Table: 9-ft. Guttman.

Air Compressors in stock to suit any of the above plants.

Sand Mills: 7 ft. 6 in., 7 ft., 6 ft., 5 ft. and 4 ft. dia. pans.

Cupolettes: 10 cwts., 15 cwts. and 20 cwts.

Cupolas: 2 and 3 tons.

Morgan Tilting Furnaces: 250 and 400 lbs.

Heavy D.E. Grinding Machine: wheels 24 in. by 4½ in.

Sand Rammers, Disintegrators and Mixers. Air Compressors, Blowers and Exhaust Fans, Moulding Machines, etc., etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.,
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

MISCELLANEOUS

REDROCK Moulding Sand, suitable for heavy iron castings and light castings, ungrounded.

STAMP BROS.,
117, BRIGHT STREET,
SHEFFIELD.

MOULDING SAND

CHURCH QUARRIES, BIRCLE,
BEST QUALITY ROAD SAND.

FOR over 30 years we have supplied this sand to many of the leading Foundries.

It is coarse, permeable, and found to be equal in all respects to the Scottish Rock Sands.

Enquiries to Head Offices, Huntley Brook Works, Bury, Lancs. Tel.: 641.

'Phone: 287 SLOUGH

OSBORN Moulding Machines, Jolt Squeeze, J75 type. Price £24 each

DORMAN Die-casting machine, Price £12

NEW Shot-blast Cabinet plant with A.C. motor driven compressor; cabinet 4′ 6″ square Price £145

ADAPTABLE Moulding Machines with tail-guides; as new. Price £16 each

EVANS Sandmill, 4′ 0″ dia. Price £22

EVANS Sandmill, 6′ 0″ dia. Price £33

Several good CORE STOVES; Cheap

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!